

**REMEDIAL ACTION CONTRACT 2 FOR  
REMEDIAL, ENFORCEMENT OVERSIGHT, AND  
NON-TIME-CRITICAL REMOVAL ACTIVITIES  
IN REGION 5**

**FEASIBILITY STUDY REPORT  
FINAL**

**US SMELTER AND LEAD REFINERY (USS LEAD)  
SUPERFUND SITE  
LAKE COUNTY, INDIANA**

**Prepared for  
United States Environmental Protection Agency  
Region 5  
77 West Jackson Boulevard  
Chicago, IL 60604**

Work Assignment No:	No. 154-RICO-053J
Contract No:	EP-S5-06-02
Date Submitted:	June 2012
Prepared by:	SulTRAC
SulTRAC Project Manager:	Rik Lantz
Telephone No:	(312) 443-0571
EPA Work Assignment Manager:	Michael Berkoff
Telephone No:	(312) 353-8983

## EXECUTIVE SUMMARY

This final feasibility study (FS) report presents information to support an informed risk-management decision regarding which remedy appears to be most appropriate for the U.S. Smelter and Lead Refinery Superfund Site (USS Lead Site) located in East Chicago, Lake County, Indiana. The objective of a FS is to develop and evaluate remedial alternatives that will address unacceptable risks and hazards to human health and the environment (as identified in the Final Remedial Investigation [RI] Report [SulTRAC 2012]) and meet applicable or relevant and appropriate requirements (ARAR). The USS Lead Site consists of the former industrial facility located at 5300 Kennedy Avenue (hereafter referred to as operable unit 2 [OU2]) and the residential area north of OU2 (hereafter referred to as OU1). This FS report focuses on OU1 of the USS Lead Site. Contamination at OU2 will be addressed as part of a separate investigation.

During the RI, surface and subsurface soils of 88 properties, consisting of 241 distinct “yards,” were sampled for metals, polycyclic aromatic hydrocarbons (PAH), and other analytes in order to characterize the nature and extent of constituents of interest (COI) in and around OU1. These 241 separate “yards” included 75 front yards, 76 back yards, 27 quadrants, and 60 drip zones, which were all considered as separate “yards” because they covered a geographic area that was not confined to a front yard, back yard, or quadrant. The term “yards” is used throughout the RI and this FS to represent one unit of remedial area. The RI soil investigation found that 113 out of the 241 yards (47 percent) sampled for lead exceeded the site screening level (SSL) for lead in surface and/or subsurface soil. In addition, a number of yards exceeded the SSLs for arsenic and PAHs.

The human health risk assessment, presented in the RI report, identified arsenic, lead, and PAHs as creating risks and/or hazards to site users. However, PAHs were determined to not be site related contaminants and are therefore not considered constituents of concern (COC).

The remedial action objective for OU1 is to reduce human health risk from exposure to surface and subsurface soil to acceptable levels by minimizing the potential for direct contact, ingestion, and inhalation exposures. Remedial action levels (RAL) for lead and arsenic were established based on regulatory requirements, standards, and guidance, and general response actions were identified to develop remedial alternatives in the FS.

As specified in the *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP), the potential alternatives encompass a range of alternatives in which treatment is used to reduce the toxicity, mobility, or volume of wastes, but vary in the degree to which long-term management of residuals or untreated waste is required. As required, a no-action alternative was also investigated.

Based on the risks present at the site and the technologies available to address them, the following six alternatives were identified, evaluated, and ranked. The **bolded** alternatives passed the initial alternative screening and were evaluated against the NCP evaluation criteria. Costs for the alternatives that passed the initial screening are also shown below.

- ☐ **Alternative 1** – No action (\$43,000)
- ☐ Alternative 2 – Institutional controls
- ☐ **Alternative 3** – On-site soil cover + Institutional controls (\$20,900,000)
- ☐ **Alternative 4A** – Excavation of soil exceeding RALs + Off-site disposal + *Ex-situ* treatment option (\$29,800,000)
- ☐ **Alternative 4B** – Excavation to native sand + Off-site disposal + *Ex-situ* treatment option (\$45,300,000)
- ☐ Alternative 5 – *In-situ* treatment by chemical stabilization

## TABLE OF CONTENTS

<b><u>Section</u></b>	<b><u>Page</u></b>
EXECUTIVE SUMMARY .....	i
LIST OF FIGURES .....	iii
LIST OF TABLES .....	iii
APPENDIX.....	iv
ACRONYMS AND ABBREVIATIONS .....	vi
1.0 INTRODUCTION .....	1
1.1 Purpose of this Feasibility Study Report .....	1
1.2 Report Organization .....	3
1.3 Site Background .....	4
1.3.1 Site Description .....	4
1.3.2 Site History .....	5
1.3.3 Nature and Extent of Contamination .....	8
1.3.4 Contaminant Fate and Transport .....	10
1.3.5 Human Health Risk Assessment Summary .....	12
1.3.6 Remedial Investigation Conclusions and Recommendations .....	13
2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES .....	26
2.1 Introduction.....	26
2.2 Applicable or Relevant and Appropriate Requirements .....	27
2.3 Remedial Action Objectives .....	28
2.4 Remedial Action Levels .....	29
2.4.1 Proposed Lead Remedial Action Levels .....	29
2.4.2 Proposed Arsenic Remedial Action Level .....	30
2.5 Proposed Soil Remediation Areas .....	31
2.5.1 Lead .....	33
2.5.2 Arsenic .....	34
2.5.3 Soil Remedial Area Summary .....	35
2.6 General Response Actions .....	35
2.7 Identification and Screening of Technology Types .....	36
2.7.1 Candidate Technology Screening .....	38
2.7.2 Retained Candidate Technologies .....	38
3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES .....	67
3.1 Introduction.....	67
3.2 Remedial Alternative Development .....	67
3.3 Screening of Remedial Alternatives .....	69
3.4 Pre-Remedial Sampling .....	70
4.0 DETAILED ANALYSIS OF RETAINED ALTERNATIVES .....	74
4.1 Introduction.....	74
4.1.1 Threshold Criteria .....	75
4.1.2 Primary Balancing Criteria .....	75
4.1.3 Modifying Criteria .....	77
4.2 Individual Alternative Analysis .....	77
4.2.1 OU1 Alternative 1 – No Action .....	77

## TABLE OF CONTENTS (CONTINUED)

<b>Section</b>	<b>Page</b>
4.2.2 OU1 Alternative 3 – On-Site Soil Cover + Institutional Controls .....	79
4.2.3 OU1 Alternative 4A – Excavation of Soil Exceeding RALs + Off-Site Disposal + <i>Ex-Situ</i> Treatment Option .....	81
4.2.4 OU1 Alternative 4B – Excavation to Native Sand + Off-Site Disposal + <i>Ex-Situ</i> Treatment Option .....	84
5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES .....	102
5.1 Overall Protection of Human Health and the Environment .....	102
5.2 Compliance with Applicable or Relevant and Appropriate Requirements .....	103
5.3 Long-term Effectiveness and Permanence .....	104
5.4 Reduction of Toxicity, Mobility, or Volume through Treatment .....	105
5.5 Short-term Effectiveness .....	105
5.6 Implementability .....	106
5.7 Cost .....	107
5.8 Summary .....	107
6.0 REFERENCES .....	112

## LIST OF FIGURES

1-1	USS Lead Residential Area Site Location Map
1-2	General Feasibility Study Process
1-3	Historical Overview of Study Area
1-4	Lead Exceedances in OU1 Yards – Surface Soil
1-5	Lead Exceedances in OU1 Yards – Subsurface Soil
1-6	Lead Exceedances in Drip Zones
1-7	Arsenic Exceedances in OU1 Yards – Surface Soil
1-8	Arsenic Exceedances in OU1 Yards – Subsurface Soil
1-9	Arsenic Exceedances in Drip Zones
1-10	Conceptual Site Model
2-1	Arsenic Concentrations in Soil as a Function of Depth
2-2	Histogram of Arsenic Concentrations at OU1

## LIST OF TABLES

2-1	List of Potentially Applicable or Relevant and Appropriate Requirements
2-2	Soil Remedial Action Levels
2-3	Total Estimated Number of Yards and Quadrants at OU1
2-4	Remedial Soil Area Estimates
2-5	Soil General Response Actions
2-6	Soil Candidate Technologies for Risk Mitigation
2-7	Soil Remediation Candidate Technologies Screening
2-8	Soil Retained Technologies for Risk Mitigation
3-1	Screening of Remedial Alternatives
4-1	Remedial Alternative Evaluation Summary
4-2	Compliance with ARARs

- 4-3 Feasibility Study Cost Estimate, Alternative 1, No Action
- 4-4 Feasibility Study Cost Estimate, Alternative 3, On-Site Soil Cover
- 4-5 Feasibility Study Cost Estimate, Alternative 4A, Excavation of Soil Exceeding RALs + Off-Site Disposal + *Ex-Situ* Treatment Option
- 4-6 Feasibility Study Cost Estimate, Alternative 4B, Excavation to Native Sand + Off-Site Disposal + *Ex-Situ* Treatment Option
- 4-7 Feasibility Study Cost Estimate Comparison
- 5-1 Comparative Evaluation of Remedial Alternatives
- 5-2 Summary of Short-Term Effectiveness Considerations

## APPENDIX

### A BASIS FOR COST ESTIMATES

- Table A-1, Soil Area and Volume Estimates
- Table A-2, Detailed Cost Estimate, Alternative 1: No Action
- Table A-3, Detailed Cost Estimate, Alternative 3: On-Site Soil Cover
- Table A-4, Detailed Cost Estimate, Alternative 4A: Excavation of Soil Exceeding RALs + Off-Site Disposal + *Ex-Situ* Treatment Option
- Table A-5, Detailed Cost Estimate, Alternative 4B: Excavation to Native Sand + Off-Site Disposal + *Ex-Situ* Treatment Option
- Table A-6, Operation and Maintenance Cost Estimate
- Table A-7, Sampling Costs

## ACRONYMS AND ABBREVIATIONS

AOC	Administrative Order of Consent
ARAR	Applicable or Relevant and Appropriate Requirements
ARCO	Atlantic Richfield Company
bgs	Below ground surface
BTV	Background threshold value
CAMU	Corrective action management unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	<i>Code of Federal Regulations</i>
CLP	Contract Laboratory Program
COC	Constituent of concern
COI	Constituent of interest
COPC	Chemical of potential concern
CSM	Conceptual site model
CTE	Central tendency exposure
DCT	Default Closure Tables
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
ERRS	Emergency Rapid Response Services
FIELDS	Field Environmental Decision Support
FS	Feasibility study
ft	Foot, feet
GRA	General response action
HASP	Health and safety plan
HHRA	Human health risk assessment
HI	Hazard index
HRS	Hazard Ranking System
IAC	Illinois Administrative Code
IDEM	Indiana Department of Environmental Management
IEUBK	Integrated Exposure Uptake Biokinetic
ISBH	Indiana State Board of Health
LDR	Land disposal restriction
MassDEP	Massachusetts Department of Environmental Protection
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
MRFI	Modified RCRA Facility Investigation
MSA	Metropolitan statistical area
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System

---

## ACRONYMS AND ABBREVIATIONS (CONTINUED)

NPL	National Priorities List
O&M	Operation and maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	Operable unit
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PRG	Preliminary remediation goal
QAPP	Quality assurance project plan
RAC	Remedial Action Contract
RAGS	Risk Assessment Guidance for Superfund
RAL	Remedial action level
RAO	Remedial action objective
RCI	Resource Consultants, Inc.
RCRA	Resource Conservation and Recovery Act
RI	Remedial investigation
RI/FS	Remedial investigation/feasibility study
RISC	Risk Integrated System of Closure
RME	Reasonable maximum exposure
RSL	Regional Screening Level
SOP	Standard operating procedure
SSL	Site screening level
SVOC	Semi-volatile organic compound
TACO	Tiered Approach to Corrective Action Objectives
TC	Toxicity characteristic
TCLP	Toxicity Characteristic Leaching Procedure
TCRA	Time Critical Removal Action
Tech Memo	Technical memorandum
USGS	United States Geological Survey
USS Lead	U.S. Smelter and Lead Refinery
UTL	Upper threshold limit
VOC	Volatile organic compound
XRF	X-ray fluorescence

## 1.0 INTRODUCTION

This final feasibility study (FS) report presents information to support an informed risk-management decision regarding which remedy appears to be most appropriate for the U.S. Smelter and Lead Refinery Superfund Site (USS Lead Site) located in Lake County, Indiana, for U.S. Environmental Protection Agency (EPA) Region 5 under Work Assignment No. 154-RICO-053J (WA 154), Remedial Action Contract No. EP-S5-06-02 (RAC 2). The purpose of WA 154 is to conduct a remedial investigation/feasibility study (RI/FS) at OU1 of the USS Lead Site to select a remedy that eliminates, reduces, or controls risks to human health and the environment.

The entire USS Lead Site consists of the former industrial facility located at 5300 Kennedy Avenue (hereafter referred to as operable unit 2 [OU2]) and the residential area north of OU2 (hereafter referred to as OU1). OU1 is bounded by East Chicago Avenue on the north, East 151<sup>st</sup> Street/149<sup>th</sup> Place on the south, the Indiana Harbor Canal on the west, and Parrish Avenue on the east (Figure 1-1). This FS report focuses on the Residential Area, OU1 of the USS Lead Site. Contamination at OU2, including groundwater at OU1 and OU2, will be addressed as part of a separate investigation.

Section 1 provides the reader with background information including the purpose and objectives of this FS, information on the Site, a summary of the remedial investigation (RI) findings, and a summary of the human health risk assessment (HHRA).

### 1.1 Purpose of this Feasibility Study Report

This process is defined in the *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 guidance, and (most specifically) in the EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final* (EPA 1988). The process was developed to gather sufficient information to support an informed risk management decision regarding which remedy appears to be most appropriate for a given Site. The RI phase included the data-collection and risk-assessment efforts. The FS phase will utilize this information to identify and evaluate remedial alternatives that appear to be most appropriate for OU1. The object of a FS is to develop and evaluate remedial alternatives that will address unacceptable risks to human health and the environment (as identified in the RI report [SulTRAC 2012]) and meet applicable or relevant and appropriate requirements (ARAR). The potential alternatives encompass, as specified in the NCP, a range of alternatives in which treatment or

controls are used to reduce the toxicity, mobility, or volume of wastes, but vary in the degree to which long-term management of residuals or untreated waste is required.

The EPA Guidance for conducting RI/FS specifies that the process should be flexible; thus, each RI/FS process may vary in its specifics (EPA1988). The general process to be followed for this FS is shown in Figure 1-2. (**Note:** The process includes review and comment steps that are not shown on the simplified flow diagram in the figure.) In general, the steps of this FS include:

1. **Applicable or Relevant and Appropriate Requirements (ARAR)**—Remedial actions performed under CERCLA must meet ARARs for selected remedies unless a specific ARAR waiver is requested. ARARs are federal, state, and local public health and environmental requirements used to characterize the extent of site cleanup, identify sensitive land areas or land uses, develop remedial alternatives, and direct site remediation. CERCLA and the NCP require that remedial actions comply with federal ARARs and also with state and local ARARs that are more stringent than their federal counterparts, as long as they are legally enforceable and consistently enforced. ARARs are evaluated early in the work planning process so that field work can be designed to collect data necessary to satisfy ARAR requirements and, if necessary, to identify and evaluate remedial alternatives relative to ARARs.
2. **Remedial Action Objectives (RAO)**—Site-specific RAOs that are protective of human health and the environment were identified and are presented in this FS. The RAOs specify the constituent of concern (COCs), exposure routes, and receptors.
3. **Remedial Action Levels (RAL)**—RALs are risk-based or ARAR-based chemical-specific concentrations that help to further establish the RAOs. The RALs are used to characterize the extent of contaminated soil requiring remedial action.
4. **General Response Actions (GRA)**—GRAs are developed by defining containment, treatment, excavation, or other actions, singly or in combination, to satisfy RAOs. The GRAs take into account requirements for protectiveness as identified in the RAOs and the site's chemical and physical characteristics.
5. **Identification and Screening of Remedial Technologies**—Applicable remedial technologies are identified and screened against the developed GRAs. Treatment technologies are identified and screened so that the most applicable technologies are selected for the contaminants present and the site's characteristics. Screening is based primarily on a technology's ability to address site contaminants effectively, but also includes implementability and cost.
6. **Remedial Alternatives Development**—Representative remedial technologies are carried forward into the alternative development stage. The effort includes combining representative technologies and GRAs into alternatives, assessing the appropriateness of the suggested alternatives, and developing the alternatives in sufficient detail for identification of action-specific ARARs.
7. **Screening of Remedial Alternatives for Effectiveness, Implementability, and Cost**—Potential remedial alternatives are screened for detailed evaluation. Alternatives are screened with respect to their effectiveness, implementability, and cost.

8. **Detailed Analysis of Remedial Alternatives**—The detailed analysis of alternatives presents the relevant information needed to compare the remedial alternatives. Detailed analysis of alternatives consists of a detailed evaluation of each alternative against the evaluation criteria set forth in the NCP.
9. **Comparative Analysis of Remedial Alternatives**—Once alternatives are individually assessed against the evaluation criteria, a comparative analysis is conducted to evaluate the performance of each alternative in relation to each evaluation criterion. This is in contrast to the preceding analysis, in which each alternative was analyzed independently without considering other alternatives. The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to the others so that the key trade-offs can be identified and balanced by decision-makers.

This process was followed with some limitations due to the fact that the site consists of contaminated soil in a residential neighborhood. EPA has issued guidance, the *Superfund Lead-Contaminated Residential Sites Handbook* (EPA 2003a), which identifies only a few actions generally considered to be long-term protective at residential sites.

The “Remedial Alternatives Screening Technical Memorandum” (Tech Memo) was prepared to develop and conduct preliminary evaluations of technologies that will remediate or control contaminated soil to provide adequate protection of human health and the environment (SulTRAC 2011). Remedial technologies were screened for the purpose of identifying preliminary remedial alternatives. The Tech Memo completed steps 1 through 6 above of this FS.

## 1.2 Report Organization

This report consists of the six sections summarized below.

- Section 1.0, Introduction: This section includes an introduction to the site, discusses the purpose of this FS, describes the site history, and presents findings of the RI and HHRA.
- Section 2.0, Identification and Screening of Technologies: This section presents the regulatory framework supporting this FS, including the ARARs, RAOs, GRAs, and RALs. Second, this section presents the identification of candidate technologies and the initial screening against effectiveness, implementability, and cost criteria. This section includes a summary of retained technologies.
- Section 3.0, Development and Screening of Alternatives: This section presents remedial alternatives and the initial alternative screening against effectiveness, implementability, and cost criteria. Second, this section presents the pre-remedial sampling plan for soil at OU1.
- Section 4.0, Detailed Analysis of Retained Alternatives: This section presents a detailed analysis of each of the retained alternatives, including a detailed description of the alternative and an evaluation against each of the nine evaluation criteria.

- Section 5.0, Comparative Analysis of Alternatives: This section presents a direct comparison of the selected alternatives based on the nine evaluation criteria.
- Section 6.0, References: This section lists the references used to prepare this report.

### **1.3 Site Background**

This section provides a brief summary of the major findings of the RI, including conclusions regarding data limitations and recommendations for future work. Specifically, the following sections summarize the site description (Section 1.3.1), site history (Section 1.3.2), nature and extent of contamination (Section 1.3.3), fate and transport (Section 1.3.4), the HHRA (Section 1.3.5), and data limitations and uncertainties of the RI (Section 1.3.6).

#### **1.3.1 Site Description**

The USS Lead Site lies approximately 18 miles southeast of Chicago, Illinois, in East Chicago, Indiana (Figure 1-1). East Chicago is located within one of the most heavily industrialized areas in the United States, including steel mills, oil refineries, heavy manufacturing, chemical processing plants, and heavy rail. OU1 is primarily low-income residential, with commercial and light industrial areas nearby. EPA considers East Chicago an environmental justice community, which means it is a community that historically is an under-represented minority and low-income area burdened with significant environmental challenges (EPA 2011a).

United States Geological Survey (USGS) historical aerial photographs from 1939, 1951, 1959, and 2005 show OU2 and OU1 over time (see RI Figure 1-3) (SulTRAC 2012). Review of these aerial photographs indicates that the majority of the residential neighborhoods within the USS Lead Site, west of the railroad tracks, were built before 1939. Because OU1 is a former low-lying area, the ground level was likely built up before 1939, before the homes were constructed. Approximately half of the homes east of the railroad tracks were built before 1939. Between 1939 and 1951, approximately 75 to 80 percent of the homes were built; by 1959, most of the homes east of the railroad tracks had been built. These photographs also show that the Anaconda Copper Company (currently the Atlantic Richfield Company [ARCO]) occupied the area where both the Gosch Elementary School and East Chicago Public Housing complex immediately south of the school are currently located (the southwest portion of OU1). The Gosch Elementary School and the East Chicago Public Housing complex were built on the former Anaconda Copper Company site after 1959. Copies of these photographs are provided in the RI Report (SulTRAC 2012).

The East Chicago area in the vicinity of OU2 has historically supported a variety of industries. Figure 1-3 shows the locations of OU1, OU2, and some of the historical industrial sites. In addition to the USS Lead smelting operation, some other industrial operations may have also managed lead and other metals. For example, immediately east of OU2, across Kennedy Avenue, is the former DuPont site (currently leased and operated by W.R. Grace & Co., Grace Davison). One of the processes that historically took place at the DuPont site was the manufacturing of the pesticide lead arsenate. Northwest of the USS Lead Site, west of Gladiola Street and north of 151<sup>st</sup> Street, two smelter operations reportedly managed lead and other metals (Geochemical Solutions 2004). A 1930 Sanborn Map identifies the operations as Anaconda Lead Products and International Lead Refining Company (referred to in this FS as the former Anaconda facility, currently owned by ARCO) (Geochemical Solutions 2004). According to the Sanborn Map, Anaconda Lead Products was a manufacturer of white lead and zinc oxide and the International Lead Refining Company was a metal refining facility. These facilities consisted of a pulverizing mill, white lead storage areas, a chemical laboratory, a machine shop, a zinc oxide experimental unit building and plant, a silver refinery, a lead refinery, a baghouse, and other miscellaneous buildings and processing areas. Locations of these possible source facilities are presented in the RI Report (SulTRAC 2012).

### 1.3.2 Site History

A graphical representation of the timeline of events at the USS Lead Site is presented as RI Figure 1-6 (SulTRAC 2012). USS Lead is a former lead smelter located at 5300 Kennedy Avenue, East Chicago, Indiana. The facility (OU2) was constructed in the early 1900s by the Delamar Copper Refinery Company to produce copper. In 1920, the property was purchased by U.S. Smelting, Refining, and Mining, and later by USS Lead. At that time, USS Lead operated a primary lead smelter at the facility. An electrolytic process called the “Betts process” was used for refining lead into high-purity lead at the Site. In the Betts process, 400-lb anodes of primary lead bullion were placed in tanks containing cathodes, anodes, and a solution of lead fluosilicate and free hydrofluosilicic acid. During electrolysis, impurities in the primary lead bullion accumulated on the anode and lead deposited on the cathode. The cathode was then removed, remelted, and treated with compressed air to oxidize and float any remaining impurities, and the purified lead was cast into lead “pigs.” The Betts process volatilized metals, including arsenic, during production (Resource Consultants, Inc. [RCI] 1990).

Between 1972 and 1973, OU2 was converted to a secondary lead smelter, which recovered lead from scrap metal and automotive batteries. A 100-ton furnace produced 1-ton lead blocks and smaller 12-lb pigs. The lead blocks and pigs were subsequently remelted and refined to soft lead, antimony lead, and calcium lead. Metal alloys used in the refining process included silver, copper, tin, antimony, and arsenic.

All operations at OU2 were discontinued in 1985. Two primary waste materials were generated as a result of the smelting operations: (1) blast-furnace slag and (2) lead-containing dust emitted from the blast-furnace stack. Blast-furnace slag was stockpiled south of the plant building and spread over an adjoining 21 acres of wetlands once per year. The blast furnace baghouse collected approximately 300 tons of baghouse flue dust per month during maximum operating conditions. Some of the baghouse dust was reintroduced into the furnace for additional lead recovery; however, not all of the dust could be recycled without a significant reduction in furnace efficiency. By the late 1970s, approximately 8,000 tons of baghouse dust was stored onsite (RCI 1990).

In 1975 and 1985, OU2 received a National Pollutant Discharge Elimination System (NPDES) permit to discharge furnace cooling water and stormwater runoff to the Grand Calumet River. According to the Indiana Department of Environmental Management (IDEM), such discharges exceeded permit levels for several compounds (EPA 2009a). In the 1980s, several state and federal enforcement actions were taken against the company. In September 1985, the Indiana State Board of Health (ISBH) found OU1 in violation of State law because lead particles were found downwind of the facility (EPA 2009a). All industrial operations at OU2 ceased in 1985 (EPA 2009a).

On November 18, 1993, EPA and USS Lead entered into an Administrative Order of Consent (AOC) pursuant to Section 3008(h) of the Resource Conservation and Recovery Act (RCRA). The AOC required USS Lead to implement interim measures, including site stabilization and construction of a corrective action management unit (CAMU) to contain contaminated soils and slag, and to conduct a Modified RCRA Facility Investigation (MRFI) at OU2 (Geochemical Solutions 2001). The CAMU covers approximately 10 acres and is surrounded by a subsurface slurry wall. Excavation and construction of the CAMU was conducted in two phases and completed between August and September 2002 (Geochemical Solutions 2004). The baghouse dust and bags were removed from the site pursuant to the IDEM Partial Interim Agreed Order in Cause No. N-296 and were sent offsite for secondary lead recovery. Slag generated from the blast-furnace operations was placed in piles on the southern portion of the property. The cleanup of slag was described in the Interim Stabilization Measures Work Plan prepared by ENTACT, LLC and was completed during the third quarter of 2002 (Geochemical Solutions 2004).

As part of a RCRA Corrective Action in 2003 and 2006, EPA conducted soil sampling in OU1 of the USS Lead Site. In the late July and early August 2003 investigation, 83 residential properties within OU1 were sampled and analyzed for lead using a Niton X-ray fluorescence (XRF) instrument. Soils from 43 locations (52 percent) exceeded the 400 milligrams per kilogram (mg/kg) residential soil screening

criterion for lead. In 2006, EPA's Field Environmental Decision Support (FIELDS) team supplemented the work performed in 2003 by collecting additional data from 14 properties sampled in 2003 to (1) assess whether the top-most soils (0 to 1 inch below ground surface [bgs]) had elevated lead concentrations relative to deeper soils (1 to 6 inches bgs), (2) collect and compare composite samples to individual samples to assess whether composite samples accurately represented the concentrations in residential yards and parks, and (3) compare lead concentrations in the fine and coarse fractions of sieved samples to evaluate whether lead was preferentially distributed in the fine-grain sizes (SulTRAC 2012).

On January 22, 2008, EPA conducted a time-critical removal action (TCRA) for private residential properties within OU1 due to elevated levels of lead in surface soils identified during investigations conducted from 2002 through 2007 (Weston 2009). EPA identified 15 private properties that contained soil with lead concentrations exceeding the regulatory removal action level of 1,200 mg/kg in the top 6 inches of soil. EPA was able to obtain access agreements to only 13 of the 15 properties. The properties were remediated between June 9 and September 22, 2008, by EPA's contractors Weston Solutions, Inc. (Weston) and Environmental Quality Management (EQM), under a TCRA. The properties were excavated to a depth of 1 to 2.5 feet bgs. Weston used an XRF instrument to field screen and confirm that excavation was completed to a depth where lead concentrations were below 400 mg/kg. The excavated properties are highlighted in blue on Figure 1-4. All the properties were backfilled with clean fill and re-sodded by September 25, 2008. A total of 1,838 tons of soil was transported offsite to a landfill facility as special waste (Weston 2009).

Under the Hazard Ranking System (HRS), the USS Lead Site was evaluated in September 2008; this evaluation determined that there was an observed release of lead in the air-migration pathway as well as in the surface-water migration pathway (EPA 2008). The USS Lead Site was listed as a Superfund site on the National Priorities List (NPL) on April 8, 2009.

EPA completed a second TCRA of 16 additional properties with lead in soil concentrations exceeding 1,200 mg/kg in the 0-6 inch soil interval from October to December 2011 based on sampling conducted during this RI. The TCRA consisted of removing lead-contaminated soil from 5 East Chicago Public Housing addresses and 11 residential properties (including 2 that were not remediated in the prior 2008 TCRA due to access issues). The TCRA was conducted between October 24 and December 9, 2011. Approximately 1913 tons of low-level lead-contaminated soil was excavated during the 2011 TCRA, and the material was sent to an off-site location for disposal. Each property was backfilled to grade and seeded after the soil removal was completed (EPA 2011b, 2011c, 2011d).

### 1.3.3 Nature and Extent of Contamination

The following section summarizes the nature and extent of contamination at the USS Lead Site. Detailed descriptions and analyses of the nature and extent of contamination are presented in Section 5 of the RI Report (SulTRAC 2012).

Between December 2009 and September 2010, as part of the RI, SulTRAC collected surface and subsurface soil samples (including drip zone samples and quadrants from larger properties such as parks and schools) from a total of 88 properties, consisting of 241 distinct yards, in order to characterize the nature and extent of constituents of interest (COI) in and around OU1. Drip zone samples are soil samples collected from beneath the gutters and downspouts of buildings, in order to investigate whether airborne contamination is or has concentrated along drip lines of roofs. These 241 separate “yards” included 75 front yards, 76 back yards, 27 quadrants, and 60 drip zones, which were considered as separate “yards” because they covered a geographic area that was not confined to a front yard, back yard, or quadrant. The term “yards” is used throughout the RI and this FS to represent one unit of remedial area, which consists of front yard, back yard, drip zones of residential properties, or any quadrant of a park, commercial property, easement, or school. A residential property can have up to three yards (front, back, drip zone) and a park, commercial property, easement, or school can be divided into a maximum of four yards (otherwise referred to as quadrants in the RI).

Soils from four different horizons (0-6 inch, 6-12 inch, 12-18 inch, and 18-24 inch bgs) were analyzed from front yards, back yards, and quadrants of larger properties. The purpose of sampling soils from different soil horizons was to evaluate vertical contamination profiles. Aerial deposition of contaminants would be expected to yield contamination profiles with higher concentrations near the surface and lower concentrations at depth.

As described in the RI Report (SulTRAC 2012), all soil samples were analyzed for lead. In addition, a subset of samples was analyzed for various combinations of total metals, volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), and pesticides to provide a basis for more fully assessing contamination in shallow soils in OU1. Although SVOCs (including PAHs), pesticides, and PCBs were sampled for and discussed in the RI, there is no reasonable expectation that consistent releases of these compounds into the OU1 area are associated with a metals smelting facility (USS Lead). Rather, detections for these compounds are associated with other anthropogenic sources typical of a metropolitan industrial area, and results discussed in the RI are intended for completeness of the RI Report only (SulTRAC 2012).

In Section 5 of the RI, each sample result was screened against an analyte-specific site screening level (SSL). SulTRAC developed these SSLs from screening criteria in the *Superfund Lead-Contaminated Residential Sites Handbook* preliminary remediation goals (PRG) (EPA 2003a), EPA residential Regional Screening Levels (RSL) (EPA 2010), IDEM's Risk Integrated System of Closure (RISC) residential Default Closure Tables (DCT) for direct contact (IDEM 2009), and site-specific background threshold values (BTV). The SSLs that were used to evaluate the RI analytical results utilized the lowest of the following: the *Superfund Lead-Contaminated Residential Sites Handbook*, the EPA residential RSL, or the IDEM RISC residential DCT. If the site-specific BTV was greater than the lowest of the above-listed values, then the site-specific BTV was selected as the SSL. The SSL for lead was 400 mg/kg and the SSL for arsenic was 14.1 mg/kg. Additional detail regarding the SSLs is available in the RI Sections 2.2 and 5.0 (SulTRAC 2012). Results from the RI soil investigation include:

- ☐ Ten metal analytes and six PAH analytes were identified as COIs
- ☐ 113/241 yards (47%) exceeded the SSL for lead in surface and/or subsurface soil
- ☐ 10/136 yards (7%) exceeded the SSL for arsenic, without also exceeding the SSL for lead, in surface and/or subsurface soil

As noted above, PAHs are not considered site-related. However, PAHs are included in this discussion for completeness. Some percentage (22%) of the yards sampled during the RI were analyzed for PAHs; however, PAHs were the COIs that exceeded the SSLs in the highest proportion of samples. 191 of the 196 samples analyzed for PAHs (97%) exceeded SSLs. Data analysis indicated that lead and arsenic were generally correlated, whereas lead and PAHs were not correlated. It is unlikely that soils exceed the arsenic SSL unless lead also exceeds the lead SSL (SulTRAC 2012). The lack of correlation between PAHs and lead supports the concept that PAHs are not site-related compounds and are likely associated with other anthropogenic sources. Figures 1-4 through 1-9 illustrate the nature and extent of lead and arsenic at the Site.

The lateral extent of lead-impacted soil includes all of OU1. The area west of Huish Avenue contained a higher frequency of exceedances for lead in both surface and subsurface soil samples than the eastern half of OU1. Lead concentrations in all nine properties (20 yards) sampled in the East Chicago Housing Authority complex, in the southwest portion of the study area, exceeded the SSL for lead. The highest arsenic and lead concentrations in all of OU1 were also found in the East Chicago Housing Authority complex and may possibly be related to the historical operations at the Anaconda Copper Company facility.

An analysis of arsenic concentrations in soils was performed to further understand site conditions at OU1 and to assess the evidence for aerial deposition of arsenic at OU1. Because arsenic concentrations in the public housing area soils likely resulted from direct deposition of contaminants from the former industrial facility and because operations at the industrial facility and construction of the housing area would likely redistribute soils, the vertical profile of arsenic in the public housing area was excluded from the analysis. If the public housing area is excluded from the arsenic data set, it becomes evident that the arsenic in the remainder of OU1 is primarily dispersed due to aerial deposition because the shallow soil horizons contain higher arsenic concentrations than the deeper soil horizons. Box plots of soil arsenic concentrations by depth interval (see Figure 5-22 of the RI Report) support the theory that arsenic was deposited aerially in OU1.

An analysis of front and back yards reveals that there is an approximately 75% chance that COIs in one yard will indicate that the other yard also contains COIs in excess of SSLs. In addition, based on the observed vertical distributions of lead, arsenic, and PAHs, there is a 13% chance that sampling only the upper two depth intervals (0-6" and 6-12" bgs) would miss contamination in the lower two depth intervals (12-18" and 18-24" bgs). A comparison of soil type to COI concentration concluded that soil type is not a reliable indicator of the presence or absence of COIs, except that the native sands are generally free of contamination (SulTRAC 2012).

In summary, the RI concluded that 53 percent of the properties in OU1 are likely to require remedial action to address risk associated with lead and 2 percent of the properties are likely to require remediation to address risks associated with arsenic only. (Note: Because different yards at the same property exhibited different concentrations of COIs, the number of yards requiring remediation is not equal to the number of properties requiring remediation.) Based on the analytical data collected during the RI, levels of VOCs, SVOCs (including PAHs), PCBs, and pesticides do not require further evaluation.

### **1.3.4 Contaminant Fate and Transport**

The following section summarizes the contaminant fate and transport at the USS Lead Site. Detailed descriptions and analyses of the contaminant fate and transport are presented in Section 6 of the RI Report (SulTRAC 2012).

The USS Lead conceptual site model (CSM) (Figure 1-10) presents four potentially affected media at the USS Lead Site: air, soil, surface water, and groundwater (SulTRAC 2012). The CSM shows that the USS Lead Site comprises historical plant/factory areas (OU2), a current residential area (OU1), and a canal, all

within an urban setting. The two historical factory/plant buildings are the most likely primary sources of contamination because airborne emissions were generated from plant stacks, and leaks and spills were likely during plant operations. In this CSM, metals are the main COIs associated with these sources. OU1 sits atop fill and topsoil which overlies native sands at approximately 2 feet (ft) bgs. The water table is approximately 8.5 ft bgs, with groundwater flowing towards the south/southwest. Contaminants are mainly transported around the site through wind (dust and airborne emissions), surface-water runoff and erosion of soils, surface-water percolation/leaching and infiltration, and filling and excavation activities (SulTRAC 2012).

Potential migration routes for COIs at the USS Lead Site were assessed according to the properties of the contaminants and fate-and-transport processes. Potential migration pathways for COIs to be released, deposited, or redistributed in surface soils include (SulTRAC 2012):

- ☐ particulate erosion and redeposition by wind
- ☐ runoff, particulate erosion, and redeposition by surface water
- ☐ surface water percolation
- ☐ surface soil filling and excavation activities

Contaminants may migrate into air via two distinct emission mechanisms: entrainment of contaminated particles by the wind and volatilization of chemical compounds. Wind and the concomitant release of dust is the primary pathway for site COIs to be released to the atmosphere due to the COIs' strong tendency to adsorb to soil particles. The most likely transport mechanism for COIs is by windborne transport of contaminated dust and soil erosion (SulTRAC 2012).

Surface-water runoff is another significant pathway that can erode surface soils and transport particles via overland flow, resulting in redeposition at lower elevations at the USS Lead Site. Because OU1 is flat and is served by a municipal sewer system, redeposition in low-lying areas is not expected to be of major significance at the site (SulTRAC 2012).

Excavation and filling activities are other migration pathways, and there has been documentation of such activities at the USS Lead Site. Excavation potentially exposes the subsurface to fugitive dust erosion and deposition. Filling activities result in topsoil that is not as compact as native soils, which may result in faster percolation and/or erosion rates. There is also a possibility that amended fill materials may be contaminated, particularly if used from the nearby, contaminated, source (SulTRAC 2012).

### 1.3.5 Human Health Risk Assessment Summary

An HHRA was conducted at the USS Lead Site during the RI. The HHRA evaluated the potential exposure of human receptors to constituents detected in environmental media at the USS Lead Site. The HHRA did not include lead in its calculations because EPA's *Superfund-Lead Contaminated Residential Sites Handbook* (EPA 2003) sets the methodology for calculating cleanup levels using the Integrated Exposure Uptake Biokinetic (IEUBK) model. As discussed in the RI, EPA evaluated the available site specific information (such as lead in drinking water and blood lead levels in children) in relation to the default exposure assumptions and concluded that there was no reason to modify the default exposure assumptions.

The objectives of the risk evaluation using the HHRA (which includes the results of the IEUBK model) were (1) to investigate whether site-related constituents detected in environmental media pose unacceptable risks to current and future human receptors and (2) to provide information to support decisions concerning the need for further evaluation or action, based upon current and reasonably anticipated future land use. For the purposes of the risk assessment, future land uses are assumed to be the same as current land uses, which are primarily residential, commercial/industrial, and recreational. Human receptors at OUI include child and adult residents; adult utility and construction workers; students; teachers (indoor and outdoor); adult and child recreationalists; and park workers (indoor and outdoor). All the receptors were assumed exposed to surface (current land use conditions) and subsurface soil (future land use conditions) via incidental ingestion, dermal contact, and inhalation of particulates in ambient air. Subsurface soils were included under future land use conditions because residents may rework soils and expose deeper horizons. In the HHRA risk characterization, the toxicity factors were integrated with concentrations of constituents of interest (COI) and intake assumptions to estimate potential cancer risks (risks) and non-carcinogenic hazards. Risks and hazards were calculated using standard risk assessment methodologies (EPA 1989). Risks were compared to EPA's risk range: from  $1 \times 10^{-6}$  (one cancer per one million exposed receptors) to  $1 \times 10^{-4}$  (one cancer per ten thousand exposed receptors). Risks less than  $1 \times 10^{-6}$  are considered insignificant. Risks within the range are remediated at the discretion of risk managers, while risks greater than  $1 \times 10^{-4}$  typically require remediation (EPA 1991). Hazards are compared to a target hazard index (HI) of 1 (EPA 1989). Risks posed by lead in soil were evaluated by comparing lead exposure point concentrations (EPC) in soil at each property to receptor-specific lead PRGs. Chemicals that have risk identified through the risk assessment process become constituents of concern (COC).

Risks associated with lead are present throughout the study area. The HHRA found that risks and hazards associated with other compounds exist under both current and future land use conditions for between 30 and 40 percent of residential properties. At these properties, risks above EPA's acceptable risk range ( $1 \times 10^{-4}$  to  $1 \times 10^{-6}$ ) and hazard index (greater than 1) are primarily driven by exposure to arsenic and PAHs through ingestion of homegrown produce and incidental ingestion of soil. As discussed in the RI and Section 1.3.3, the PAHs detected in soil at OU1 are typical of urban soils in the Chicago metropolitan statistical area (MSA) and are not related to any specific onsite sources. Therefore, PAHs are not being addressed as COCs in this FS (SulTRAC 2012). Additional information regarding the HHRA can be found in Section 7.0 and Appendix E of the RI Report (SulTRAC 2012).

In addition, as further discussed in Section 2.4.2, a risk management decision was made to address risk from arsenic concentrations in soil that exceed the Upper Tolerance Limit (UTL) for arsenic. Because of the similarity between the bulk soil concentrations for arsenic at OU1 and the background concentrations discussed above, it is appropriate to calculate a UTL for arsenic concentrations in soil to distinguish between soil concentrations that are distributed among the naturally occurring values at the site and those that may be impacted by activities in and around the site. The approach of using the UTL as a value for the RAL has been used at other CERCLA sites, including the Jacobsville Neighborhood Soil Contamination Site in Evansville, Indiana as discussed in the site's *Final Remedial Investigation Report* (CH2M HILL 2006).

### **1.3.6 Remedial Investigation Conclusions and Recommendations**

The purpose of the RI at OU1 was to evaluate the nature and extent of contamination in soil and to assess the associated human health risks. Based on the nature and extent summary and HHRA above, COCs at OU1 are lead and arsenic. Data analysis indicated that lead and arsenic were generally collocated. It is unlikely that soils exceed the arsenic preliminary RAL unless lead also exceeds the preliminary RAL for lead (SulTRAC 2012).

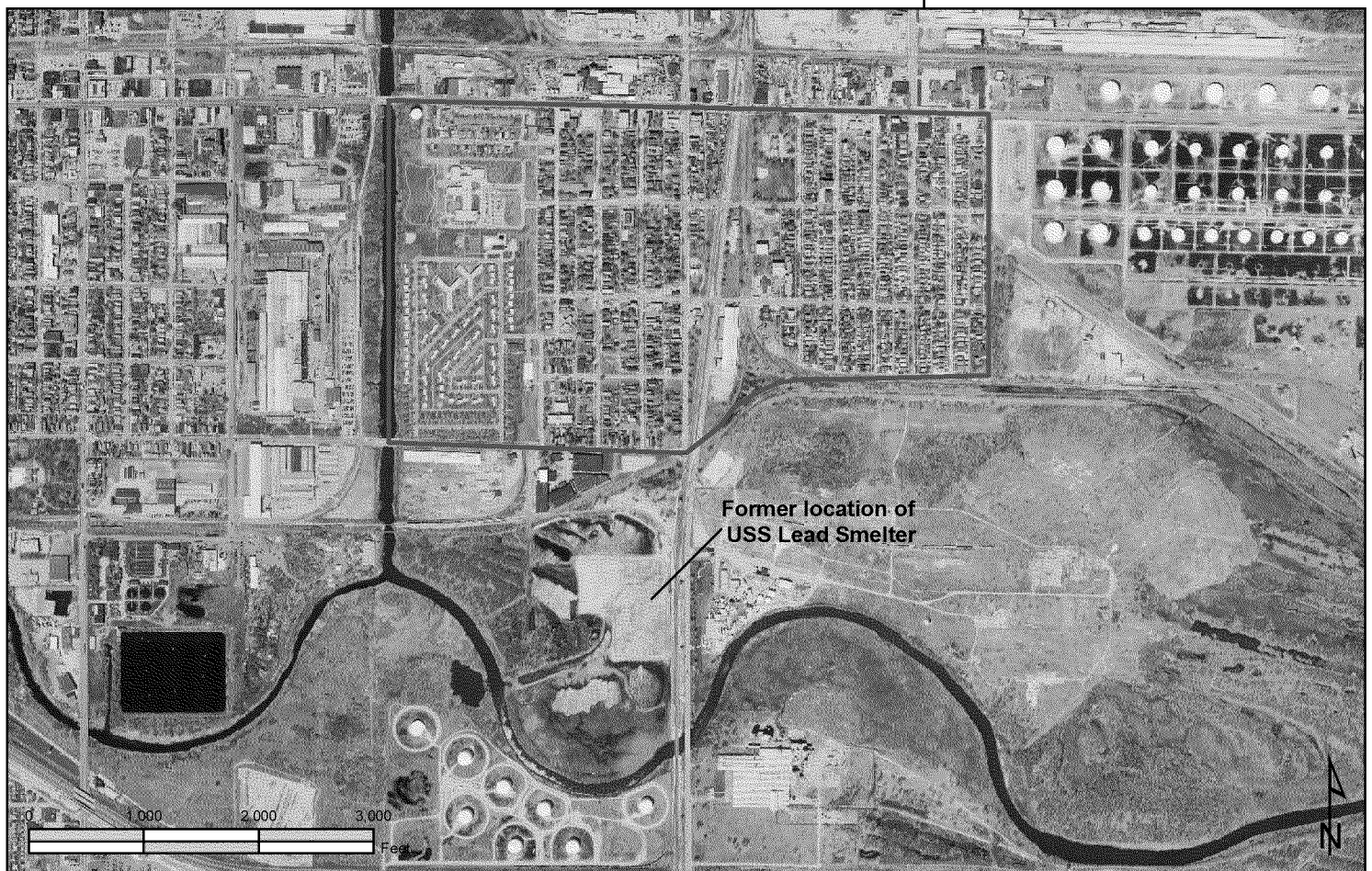
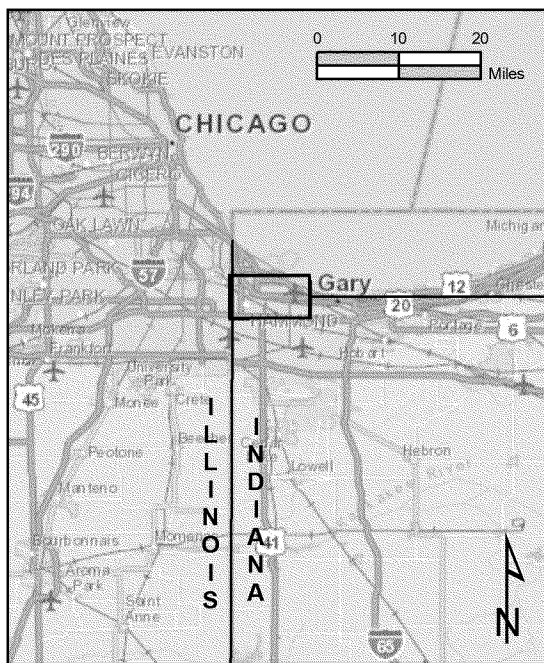
Lead is the primary COC at the USS Lead site. Based on lead concentrations observed during the RI, lead-contaminated soils at the USS Lead site require remedial action to address unacceptable risks. Because of the inconsistent distribution of lead and arsenic contamination throughout OU1, it is suggested that soils from each property where access can be obtained be sampled for lead and arsenic. As stated earlier, further evaluation of PAHs in soil during future work at the site is not recommended, as it has not been demonstrated that soil PAH concentrations exist at OU1 above the levels that would normally be


expected in urban soils in the Chicago MSA. In addition, there is no reasonable expectation that PAHs were generated and released as part of activities conducted at the USS Lead (OU2) facility (SulTRAC 2012).

Drip zone samples were collected during the RI to investigate whether aerial deposition of contaminants was concentrated in the drip zone soils around a building. The RI identified only 3 of the 60 properties sampled that had a COI exceed an SSL in the drip zone where there was not also an exceedance in either the front or back yard (SulTRAC 2012). Therefore, going forward in this FS and the remedial design, independent drip zone samples need not be collected, and the drip zone area at each property should be conjoined with the adjacent front or back yard. The three properties (one on Grasselli Avenue and two on Carey Street) where the drip zone exceeded the SSL and the adjacent yards should be re-sampled during pre-remedial sampling. For the purposes of this FS, it was assumed that the front and back yards of these three properties would be remediated.

## FIGURES

- 1-1 USS Lead Residential Area Site Location Map
- 1-2 General Feasibility Study Process
- 1-3 Historical Overview of Study Area
- 1-4 Lead Exceedances in OU1 Yards – Surface Soil
- 1-5 Lead Exceedances in OU1 Yards – Subsurface Soil
- 1-6 Lead Exceedances in Drip Zones
- 1-7 Arsenic Exceedances in OU1 Yards – Surface Soil
- 1-8 Arsenic Exceedances in OU1 Yards – Subsurface Soil
- 1-9 Arsenic Exceedances in Drip Zones
- 1-10 Conceptual Site Model



 OU1 boundary

Imagery sources (clockwise from upper left):  
 ESRI Resource Center  
 Google Maps  
 ISDP (Indiana Spatial Data Portal)



US SMELTER & LEAD REFINERY  
 LAKE COUNTY, EAST CHICAGO, INDIANA

DRAFT FEASIBILITY STUDY



# **FIGURE 1-1** **USS LEAD RESIDENTIAL AREA** **SITE LOCATION MAP**

EPA REGION 5 RAC 2 | REVISION 0 | JUNE 2012

**ST** **SulTRAC**





-  OU1 boundary
-  Industrial sites

Imagery source:  
ISDP (Indiana Spatial Data Portal)



US SMELTER & LEAD REFINERY  
LAKE COUNTY, EAST CHICAGO, INDIANA  
REMEDIAL INVESTIGATION REPORT

**FIGURE 1-3**  
**HISTORICAL INDUSTRIAL SITES**  
**NEAR USS LEAD SITE**

EPA REGION 5 RAC 2 | REVISION 0 | JUNE 2012



**Figure 1-4      Lead Exceedances in OU1 Yards – Surface Soil**

**REDACTED**

**Figure 1-5      Lead Exceedances in OU1 Yards – Subsurface Soil**

**REDACTED**

**Figure 1-6      Lead Exceedances in Drip Zones**  
**REDACTED**

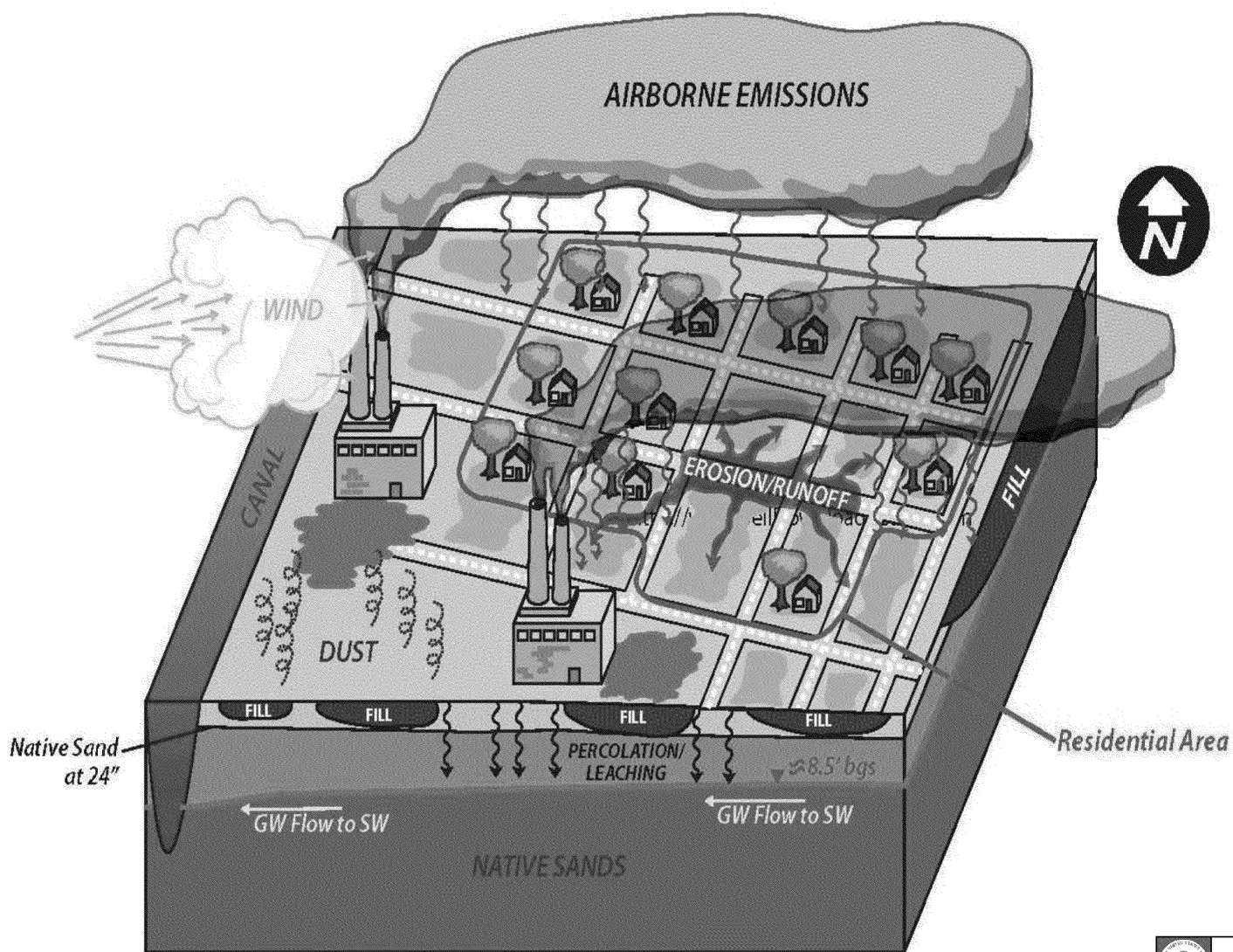
**Figure 1-7      Arsenic Exceedances in OU1 Yards – Surface Soil**



**REDACTED**

**Figure 1-8      Arsenic Exceedances in OU1 Yards – Subsurface Soil**

**REDACTED**

**Figure 1-9      Arsenic Exceedances in Drip Zones**  
**REDACTED**



	US SMELTER & LEAD REFINERY LAKE COUNTY, EAST CHICAGO, INDIANA		
	DRAFT FEASIBILITY STUDY		
	<b>FIGURE 1-10</b>		
	CONCEPTUAL SITE MODEL		
EPA REGION 5 RAC 2	REVISION 0	JUNE 2012	
 <b>SuITRAC</b>			

## **2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES**

This section presents the regulatory framework supporting this FS and is organized as follows: Introduction (Section 2.1), followed by identifying ARARs at the federal, state, and local levels (Section 2.2). Next, an RAO is identified that will protect human health (Section 2.3). Then, the proposed RALs for lead and arsenic are presented (Section 2.4), followed by the proposed remedial areas for arsenic and lead (Section 2.5). Afterwards, the GRAs for soil are presented (Section 2.6). Lastly, the candidate technologies are screened and technologies are eliminated that would not be effective or implementable, or are of a higher cost relative to other identified technologies without providing additional benefit (Section 2.7).

### **2.1 Introduction**

The process of identifying and screening technologies begins with the creation of the remedial objectives. The remedial objectives of the FS process include the ARARs, RAOs, and RALs.

CERCLA specifies that Superfund remedial actions must meet any federal standards, requirements, criteria, or limitations that are determined to be legally ARARs. Also included is the provision that state ARARs must be met if they are more stringent than federal requirements (EPA 1988). The RAOs consist of soil goals for protecting human health. The RALs are the final acceptable exposure levels of the remedial action. The RALs will address soil lead and arsenic EPCs which are less than soil PRGs, cancer risks greater than  $1 \times 10^{-6}$ , and non-cancer hazards greater than 1. The RALs will be selected on the basis of the results of the HHRA, the evaluation of the expected exposures and associated risks for each alternative, and on the exposure to contaminated soils (EPA 1988). Together the ARARs, RAOs, and RALs create the site-specific “regulatory” framework for the remedial action, and hence, the final remedy to meet.

General response actions (GRA) are broad categories of possible remedial actions, such as containment or removal. Technologies are separated into GRA categories. Potential technologies are identified in order to identify those that may be capable of attaining the RAOs. The established performance of each technology with regard to site contaminants and conditions is considered during the identification and screening process, when potential technologies are evaluated based on effectiveness, implementability, and relative cost.

## 2.2 Applicable or Relevant and Appropriate Requirements

Regulatory requirements, standards, and guidance are referred to as ARARs. ARARs depend on the detected contaminants, specific site characteristics, and particular remedial actions proposed for the site. This section discusses the identification of ARARs for OU1.

Under Section 121(d)(1) of CERCLA, remedial actions must be protective of human health and the environment. Additionally, CERCLA remedial actions must meet a level and standard of control that attains standards, requirements, limitations, or criteria that are “applicable or relevant and appropriate” under the circumstances of the release. These requirements are derived from federal and state laws and are known as ARARs. Federal, state, or local permits are not necessary for removal or remedial actions implemented under a CERCLA remedial action, but applicable substantive requirements or ARARs must be met.

The NCP (40 *Code of Federal Regulations* [CFR] 300.5) defines “applicable requirements” as

“...those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.”

The NCP (40 CFR 300.5) defines “relevant and appropriate requirements” as

“...those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.”

State requirements identified in a timely manner and that are more stringent than corresponding federal requirements may be applicable or relevant and appropriate. Three types of ARARs have been identified on a site-specific basis for the USS Lead Site: chemical-, location-, and action-specific ARARs. Each type of ARAR is briefly described below.

**Chemical-specific ARARs** are health- and risk-based numerical values and methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values and methodologies (such as promulgated standards and risk assessments, respectively) establish acceptable concentrations of a chemical contaminant that may remain in the environment.

**Location-specific ARARs** are restrictions placed on the concentrations of hazardous substances or the conduct of activities solely because the site-specific location is of environmental importance.

**Action-specific ARARs** are technology- or activity-based requirements or limitations on actions to be taken with respect to hazardous wastes. These requirements are triggered by the particular remedial activities selected to accomplish a remedy.

This FS considers all federal and state requirements as potential ARARs for OU1. Table 2-1 summarizes the specific ARARs identified as “to be considered,” “potentially applicable,” or “relevant and appropriate” for soil at OU1.

### 2.3 Remedial Action Objectives

RAOs are goals specific to media or operable units for protecting human health and the environment. Risk can be associated with current or potential future exposures. RAOs should be as specific as possible, but not so specific that the range of alternatives to be developed is unduly limited. Objectives aimed at protecting human health and the environment should specify: (1) COCs; (2) exposure routes and receptors; and (3) an acceptable contaminant level or range of levels for each exposure route (that is, a RAL) (EPA 1988).

The USS Lead OU1 HHRA recognized the following receptors for current and future land-use scenarios: child, adolescent, and adult residents; child, adolescent, and adult recreationalists; and adult indoor and outdoor workers. Section 7.2 of the RI details the exposure routes for each receptor (SulTRAC 2012). Current land uses within OU1 include residential, recreational, school, and industrial/commercial properties. For the purpose of the HHRA, future land uses of all properties are assumed to be the same as current land uses. In addition to the primary types of receptors associated with each property (for example, adult and child residents at residences, and students, faculty, and staff at schools, etc.), the risk assessment also considers potential exposures of workers involved in utility installation and repair and construction activities at each property (SulTRAC 2012).

The NCP requires that a range of risks (1E-04 to 1E-06 excess lifetime cancer risk) be evaluated (EPA 1994). Higher risks (1E-04) may be considered when the exposed population is small, risks were developed using very conservative assumptions, and where it is unlikely that children and other sensitive sub-populations would be exposed (SulTRAC 2012). However, the risk thresholds ultimately will be selected by EPA based on site-specific conditions and factors.

The proposed RAO for OU1 is to:

- **Reduce to acceptable levels human health risk from exposure to COCs in impacted surface and subsurface soils, through ingestion, direct contact, or inhalation exposure pathways, assuming reasonably anticipated future land-use scenarios.**

As stated in soil boring logs and notes from the RI, fill material is prevalent throughout OU1. Portions of OU1 are currently paved or covered with buildings, limiting potential exposure. However, significant portions of the site, representing yards, parks, and lawns, are unpaved. The intent of this RAO is to address open areas to protect residents, recreationalists, and workers.

## **2.4 Remedial Action Levels**

RALs are COI concentrations used during the analysis and selection of remedial alternatives, and during the remedial design and remedial action processes (see Table 2-2). The proposed RALs for OU1 comply with ARARs and support the RAO presented in Sections 2.2 and 2.3, respectively. The RALs presented in Sections 2.4.1 and 2.4.2 below are considered proposed, because final RALs will be established in the Record of Decision once the remedy for OU1 is selected. The RALs are used to estimate the extent of contaminated soil requiring remedial action. The residual risks (including both carcinogenic risks and noncarcinogenic hazards) comply with the NCP requirements for protection of human health and the environment. The RALs are presented for residential and industrial/commercial property uses. In the RI and this FS, residences, recreational parks, schools, and churches are assessed as residential areas. Industrial/commercial areas include businesses, industrial properties, rights-of-way, and easements.

The RALs were calculated based on site-specific risks and hazards from the human health and ecological risk assessments, as presented in the RI (SulTRAC 2012). The RALs below address soil lead EPCs less than soil PRGs, cancer risks greater than E1-06, and non-cancer hazards greater than 1. The primary COCs are lead and arsenic. RALs for the soil at OU1 are presented below and in Table 2-2.

### **2.4.1 Proposed Lead Remedial Action Levels**

The proposed RAL for lead at OU1 is 400 mg/kg for residential areas and 800 mg/kg for industrial/commercial areas (see Table 2-2). The RAL is based on the *Superfund Lead-Contaminated Residential Sites Handbook* (EPA 2003a), EPA RSLs (EPA 2010), and the State of Indiana's *RISC Technical Resource Guidance Document* for direct contact with soils (IDEM 2009). In addition, EPA used the Integrated Exposure Uptake Biokinetic (IEUBK) Model and the Adult Lead Model (ALM) to

estimate soil concentrations that correspond to acceptable blood-lead concentrations for residents and non-residents, respectively (EPA 2003b; 2009b, c). As discussed in the RI, EPA evaluated the available site specific information (such as lead in drinking water and blood lead levels in children) in relation to the default exposure assumptions and concluded that there was no reason to modify the default exposure assumptions. The HHRA (Appendix E to the RI report) presents the methodology based on the IEUBK and ALM models used to calculate acceptable receptor-specific soil lead concentrations (referred to as preliminary remediation goals [PRG]). The lead PRGs were compared to the lead EPCs (average lead concentrations) to evaluate whether adverse effects could result from exposure to lead in soil. For residential child receptors, the average lead concentration in soil at each property was compared to the EPA residential soil RSL of 400 mg/kg. The 400 mg/kg RSL was calculated using EPA's IEUBK model and default exposure assumptions. EPA concluded that insufficient site-specific information (for example, localized concentrations of lead in air, water, and foodstuffs) was available to warrant calculation of a site-specific residential soil PRG. Therefore, residential properties with average lead concentrations in soil greater than 400 mg/kg were identified as presenting potential lead risks to residential receptors.

#### **2.4.2 Proposed Arsenic Remedial Action Level**

The proposed RAL for arsenic at OU1 is 26 mg/kg (see Table 2-2), based on the 95% UTL of the collected and analyzed arsenic data from the RI report (SulTRAC 2012).

As described in Section 5.1 of the RI report, the background arsenic concentration was calculated to be 14.1 mg/kg, based on the nine soil samples collected specifically to evaluate background concentrations at OU1. Comparison of the health-based EPA RSL (EPA 2010) for arsenic (0.39 mg/kg) to site-specific background concentrations indicates the presence of naturally occurring arsenic at the site. The Illinois EPA has determined background arsenic concentrations in metropolitan soils to be 13.0 mg/kg (35 Illinois Administrative Code [IAC] IAC Part 742) (Indiana does not have an equivalent background soil measurement). Although the USS Lead Site is not within Illinois, it is approximately 5 miles from the City of Chicago and the Illinois-Indiana state border. Use of the site-specific background level of 14.1 mg/kg was considered acceptable, based on the similarity between the metropolitan area background levels and those measured at OU1.

To better evaluate a proposed RAL for arsenic, a UTL was calculated to distinguish a breakpoint between soil concentrations that are naturally occurring at the site and those that may be impacted by activities in and around the site. In this respect, the UTL is comparable to a BTV. As shown in Figure 2-1, arsenic

concentrations in soil samples collected within OU1 are distributed around both the site-specific background concentration of 14.1 mg/kg and the Illinois EPA metropolitan background concentration of 13.0 mg/kg. Because of the similarity between the bulk soil concentrations for arsenic at OU1 and the naturally occurring background concentrations discussed above, it is appropriate to calculate a UTL for arsenic. The approach of using the UTL as an RAL (comparable to the BTV) has been used at other CERCLA sites, including the Jacobsville Neighborhood Soil Contamination Site in Evansville, Indiana as discussed in the site's *Final Remedial Investigation Report* (CH2M HILL 2006).

The UTL for arsenic at the USS Lead site was calculated using EPA's statistical program ProUCL version 4.1.01. The program tested for data outliers and for normal or lognormal distribution of the data. Arsenic concentrations contained in this set of "outliers" are associated with impacted samples that are not considered part of the naturally occurring soil distribution and were excluded from the UTL calculation. Twenty-five individual data points ranging in concentration from 46.2 to 414 mg/kg were considered to be outliers and were excluded from the UTL analysis. The remaining data set of arsenic concentrations from samples at OU1 (n= 315) had a calculated mean of 13.16 mg/kg, similar to the background values above, and did not exhibit a normal distribution around the mean (Lilliefors Test Statistic = 0.159, Lilliefors Critical Value at 5% = 0.0499). Figure 2-2 illustrates that the data set for arsenic at OU1 approaches a lognormal distribution; however, the test for lognormality of the data rejects this hypothesis at the 5% significance level (Lilliefors Test Statistic = 0.0566, Lilliefors Critical Value at 5% = 0.0499). Because the data were distributed neither normally nor lognormally, no clear-cut approach to statistical treatment of the dataset is apparent. The data were assumed to be lognormally distributed because the data more closely approached a lognormal distribution and it was felt that the UTL calculated by ProUCL from the non-parametric test (28 mg/kg) was too close to the  $1 \times 10^{-4}$  risk level for arsenic (30 mg/kg). A 95% UTL of 26.36 mg/kg was calculated by ProUCL using the log transformed data. The 95% UTL value of 26 mg/kg was taken as the upper bound of the naturally occurring arsenic at OU1, and the arsenic preliminary RAL for the site was set at 26 mg/kg.

## 2.5 Proposed Soil Remediation Areas

The purpose of the RI at OU1 was to evaluate the nature and extent of contamination in soil and to assess the associated human health risks. The total number of properties in OU1, including the public housing area, is 1,271 based on county tax records. Because the RI established that contamination in front yards is not closely correlated with contamination in back yards, this FS considered each yard independently, rather than evaluating cleanups by property. Each property consists of 1 or more yards. Parks, right-of-

ways, churches, and commercial/industrial properties were divided into quadrants, as recommended by EPA's *Superfund Lead-Contaminated Residential Sites Handbook* (EPA 2003a). In order to provide a more meaningful evaluation of the extent of contamination at OU1, the residential area was divided into three sections, based on similarities of observed contaminant distribution. The three sections that comprise OU1 are

**The Eastern Area** (east of Huish Avenue). The Eastern Area includes 490 residential properties, 3 park/church properties (including 3 park or church properties, such as Riley Park and the Carmelite Home for Girls), 13 industrial/commercial properties, and 11 former railroad right-of-way properties;

**The Southwestern Area** (west of Huish Avenue, south of 149<sup>th</sup> Street and south of Carrie Gosch Elementary School property). The Southwestern Area includes 345 residential properties, 3 park/church properties (including Kennedy Park and Goodman Park), 13 industrial/commercial properties, and 2 easements. Each of the 93 structures in the public housing area (including multifamily units) was considered a single property.

**The Northwestern Area** (west of Huish Avenue, north of 149<sup>th</sup> Street, including Carrie Gosch Elementary School). The Northwestern Area includes 339 residential properties, 5 park/church properties (including Martin Luther King Park and Carrie Gosch Elementary School), 43 industrial/commercial properties, and 4 easements.

It was not practical to “count” the number of yards in the residential properties of OU1, because some properties had only a front or back yard, and in other properties, the front and/or back yards were paved. It is possible to estimate the number of yards in each of the three sections of OU1 by assuming that each residential property consists of two “yards” (front and back yard) and that each non-residential property (park, commercial property, or school) can be divided into four quadrants (which are referred to as “yards” for consistency with residential properties). Based on these assumptions, estimates of the number of properties and yards in each of the three areas can be made as listed in Table 2-3. The alternative costs developed in Section 4.0 are divided by the three areas.

Based on the HHRA discussion in Section 7 of this FS report and Section 8.3 of the RI, COCs at OU1 are lead and arsenic. The RI presented the estimated extent of contamination for each COC separately, as well as the places where the COCs overlap. For this FS, the anticipated remediation areas will be based on those yards that are expected to exceed the RAL for lead and/or arsenic only.

The calculations in this Final FS for the estimated number of yards expected to require remediation, the estimated volume of soil to be remediated, and the estimated cost of the remediation program for each individual area are all based on extrapolations from the limited number of soil samples and analyses for lead and arsenic summarized in the RI.

A summary of the methodology used to estimate the number of residential yards that will require remediation is provided below. Note that, as mentioned above in Section 1.3.6, the RI recommended pre-remedial sampling of every yard for lead and arsenic as part of the RD to evaluate if the yard requires remediation. The cost estimates in Section 4.0 below will be revised after the pre-remedial sampling is conducted and during the remedial design phase. Each COC is discussed separately below.

### **2.5.1 Lead**

The proposed RALs for lead at OU1 were calculated using the standard inputs for the IEUBK model resulting in preliminary RALs of 400 mg/kg for residential areas and 800 mg/kg for industrial/commercial areas. As discussed in the RI, 16 percent of the residential properties sampled exhibited risk for lead only and 38 percent of residential properties sampled exhibited risk for lead and arsenic (SulTRAC 2012). The estimated total number of yards requiring remediation for lead is discussed below.

Consistently high concentrations of lead in soil were located in the southwest area, in the vicinity of the East Chicago Housing Authority complex, which was historically occupied by the former Anaconda Copper Company. According to the Lake County, Indiana assessor's office, the East Chicago Housing Authority complex was constructed in the early 1970s. The high lead concentrations in this area are possibly related to the historical operations at the Anaconda Copper Company facility. A consistent distribution of lead in soil was not found in the eastern or the northwestern area of OU1.

Lead concentrations in soil across OU1 were found to be dissimilar between yards on the same property. Further work at OU1 will need to consider each property and each yard on a given property individually.

Section 5.4.3.1 of the RI contained a more detailed analysis of lead concentrations in soils to assess the presence or absence of aerial deposition of lead at OU1. RI Figures 5-20 and 5-21 show soil lead data plotted by depth interval. The figures show a decreasing trend in soil-lead concentrations with increasing depth, suggesting that aerial deposition is a source for lead in soil at OU1.

Drip zones were sampled during the RI to evaluate the possible impact of aerial deposition of lead. As discussed in Section 1.5.6 above, drip zone results from two properties sampled during the RI showed elevated lead concentrations while the rest of the property did not. The RI supports the theory of aerial distribution of lead; however lead results in yards and drip zones at the same properties were inconsistent. Therefore, during the FS, drip zones will not be assessed or remediated independently of the adjacent yards. Each residential front and back yard will include the soil up to the building foundation.

Elevated lead concentrations were found in the fill material across OU1. The native sand generally encountered at a depth of 18 to 24 inches bgs was found to be free of elevated lead concentrations. By including historical data, but excluding drip zone samples, lead concentrations in soils are available for 241 yards in OU1. Soil samples from 113 of these yards (47%) exceeded the RAL for lead.

There are approximately 2,702 yards within OU1 (including front yards, back yards, parks, schools, churches, industrial/commercial properties, and easements), which are divided among 1,271 separate properties. Extrapolating from the frequency of lead exceedances during the RI for each type of yard (residential, park/church, commercial/industrial/right-of-way) to all of OU1, approximately 1,223 yards would require remediation based on exceedances of the lead RALs. Details on the total area (in square feet) requiring remediation are described in Section 2.5.4 and Table 2-4.

During the RI, an analysis of the correlation between total lead concentration and Toxicity Characteristic Leaching Procedure (TCLP) sample results found that soil sample results containing total lead concentrations above 2,400 mg/kg may exhibit characteristics of hazardous waste and may require disposal as hazardous waste or pre-treatment (SulTRAC 2012). During the RI, a total of 16 yards had soil lead concentrations above 2,400 mg/kg. Sixteen yards represent approximately 7 percent of the total yards sampled. Land disposal restrictions (LDR) will require treatment of soils exceeding the TCLP limit of 5 milligrams per liter (mg/L) for lead before disposal. Based on this estimate of the total number of yards and the percentage of yards with soil lead concentrations above 2,400 mg/kg, it is estimated that 86 yards (7% of the 1,223 yards anticipated to be addressed for lead based on RALs in the remedial action) will require treatment for lead before disposal.

### **2.5.2 Arsenic**

The proposed RAL for arsenic at OU1 has been set at 26 mg/kg for residential and industrial/commercial properties, based on 95% UTL of the arsenic sample results. All soil samples collected during the RI were analyzed for lead, and a subset of the samples was also analyzed for arsenic. Of the 117 yards that contained samples analyzed for both lead and arsenic, soils from 25 yards (21%) exceed the proposed

RAL for both lead and arsenic, while soils from 4 yards (3%) exceeded the proposed RAL for arsenic but did not exceed the proposed RAL for lead.

There are approximately 2,702 yards within OU1. Extrapolating from the frequency of arsenic exceedances during the RI for each type of yard (residential, park/church, commercial/industrial/right-of-way) to all of OU1, approximately 67 yards will require remediation based solely on exceedances of the arsenic RAL. Based on the RI results, all of the properties that require remediation only for arsenic will likely be located in the Eastern Area. Details on the total area (in square feet) requiring remediation are described in Section 2.5.4 below and Table 2-4.

### **2.5.3 Soil Remedial Area Summary**

Extrapolating from the frequency of RAL exceedances (lead and arsenic) from each type of yard sampled during the RI to all of the yards in OU1, approximately 1,290 of the estimated total 2,702 yards (47%) will require remediation for lead and/or arsenic. The number of yards sampled during the RI, together with the frequency (as a percentage) of yards above the RAL is summarized in Table 2-4. Table 2-4 is divided into the three geographic areas (eastern, southwestern, and northwestern), then divided by yard type (front/back, park/school/church, industrial/commercial/easement). The number of yards within OU1 for each geographic area and property use are listed in the second column. The property type (residential or non-residential) is shown for each yard type. The number of yards with RAL exceedances is extrapolated from the RI results to the entire OU1 area, and is summarized in the “No. yards that require remediation” column of Table 2-4. Finally, the estimated average area of each yard is multiplied by the “No. yards that require remediation” to estimate the “Total area requiring remediation” (in square feet). A more detailed assessment of the number of yards that exceed an RAL can be found in Appendix A, Table A-1, Soil Area and Volume Estimates. The area for residential yards was estimated by averaging ten residential lot sizes minus the area of the house, garage, and driveway/sidewalk. The average lot size was divided by two to get an estimated average yard area that might require remedial action. Soil volumes requiring remedial action vary between alternatives. The methodology for estimating soil volumes requiring remedial action will be presented in Section 4.0, Detailed Analysis of Retained Alternatives.

## **2.6 General Response Actions**

This section presents the GRAs developed to achieve the proposed RAO identified in Section 2.3. GRAs are broad categories of possible remedial actions, such as containment or removal. Technologies are

separated into GRA categories. Potential technologies are identified in order to evaluate those that may be capable of attaining the RAO. The established performance of each technology with regard to site contaminants and conditions is considered during technology identification and screening. The potential technologies are screened based on effectiveness, implementability, and relative cost. The GRAs are then used to identify specific remedial technologies that may be implemented at the site.

GRAs for OU1 soil at the USS Lead Site are listed in Table 2-5. As noted, the GRAs are used to identify and group potential remedial technologies. The following GRAs are included in Table 2-5.

- ☐ No Action
- ☐ Institutional Controls
- ☐ Removal
- ☐ Disposal
- ☐ Containment
- ☐ *In Situ* Treatment
- ☐ *Ex Situ* Treatment

## 2.7 Identification and Screening of Technology Types

This section discusses the identification and screening of remedial technologies proposed for the remediation of OU1. The identification and screening are performed using the processes outlined in the EPA's RI/FS guidance (EPA 1988) and the NCP (EPA 1994). First, technologies that may be capable of attaining the proposed RAO listed in Section 2.3 are identified. The *Superfund Lead-Contaminated Residential Sites Handbook* was referenced to develop a list of potential remedial technologies that may be used to attain the proposed RAO (EPA 2003a). During technology identification, the demonstrated performance of each technology with regard to site contaminants and conditions is considered. The result is a list of potential remedial technologies that are then screened based on effectiveness, implementability, and relative cost. The purpose of this screening is to produce an inventory of suitable technologies that can be assembled into candidate remedial alternatives capable of mitigating actual or potential risks at OU1. Consistent with EPA guidance, an extensive list of potential technologies representing a range of GRAs was considered to develop the candidate remedial alternatives.

Categories of remedial technologies were identified based on a review of literature, vendor information, performance data, and experience in developing other FSs under CERCLA. Technologies considered potentially applicable to achieving the RAO were selected for screening. The technology screening process reduces the number of potentially applicable technologies by evaluating factors that may influence process-option effectiveness and implementability. This overall screening is consistent with guidance for performing FSs under CERCLA (EPA 1988).

The screening process assesses each technology for its probable effectiveness, implementability, and relative cost with regard to site-specific conditions, site-related contaminants, and affected environmental media. The effectiveness evaluation focuses on (1) whether the technology is capable of handling the estimated areas or volumes of media and meeting the contaminant reduction goals identified in the RAO, (2) the effectiveness of the technology in protecting human health and the environment during the construction and implementation phases, and (3) how proven and reliable the technology is with respect to contaminants and conditions at the site.

Implementability encompasses both the technical and administrative feasibility of implementing a technology process. Technical implementability is used as an initial screen of technology types to eliminate those that are clearly ineffective or unworkable at a site. Technical implementability is used as a check that the technology is applicable to the site. The more detailed evaluation of technologies places greater emphasis on the institutional aspects of implementability, such as the ability to obtain necessary permits for off-site actions; the availability of treatment, storage, and disposal services (including capacity); and the availability of necessary equipment and skilled workers to implement the technology. For technology screening purposes, implementability is broken down to three levels: easy to implement, implementable, and difficult to implement.

Cost plays a limited role in the screening of technologies. Relative capital and operation and maintenance (O&M) costs, rather than detailed estimates, are considered. At this stage in the process, the cost analysis is made on the basis of engineering judgment, and each technology is evaluated as to whether costs are high, low, or moderate relative to other technology options for the same medium (EPA 1988). The relative cost for each technology was estimated in terms of general technology cost, not site-specific cost.

A two-step process was used in this effort. The initial step was to identify a wide range of potential technologies based on past experience and general knowledge of remedial options. The second step was to conduct the initial screening of these technologies as described above. The product of this effort is a list of retained technologies to be considered when developing potential remedial alternatives to be carried forward to the FS alternatives evaluation process. The following sections identify and discuss the possible remedial technologies for OU1.

Identified candidate technologies for mitigation of risk are presented in Table 2-6, Soil Candidate Technologies for Risk Mitigation, which includes a list of candidate technologies, a brief description of each technology, and specific comments on the application of the technology. The following candidate technologies, separated by GRA, are included in Table 2-6.

- ☐ No Action
  - No Action
- ☐ Institutional Controls
  - Property use restrictions
  - Property access restrictions
- ☐ Removal
  - Mechanical excavation
  - Hand excavation
- ☐ Disposal
  - Off-site disposal to a RCRA Subtitle C hazardous-waste landfill
  - Off-site disposal to a RCRA Subtitle D solid-waste landfill
- ☐ Containment
  - Low-permeability cap
  - Soil cover
- ☐ *In Situ* Treatment
  - Chemical stabilization
  - Vitrification
  - Bioleaching
  - Biosolids remediation
  - Phytoremediation
- ☐ *Ex Situ* Treatment
  - Soil washing
  - Pyrometallurgical recovery
  - *Ex situ* solidification/stabilization
  - Chemical extraction

### 2.7.1 Candidate Technology Screening

The potential technologies identified in Table 2-6 were screened for effectiveness, implementability, and relative cost as described above. The potential technologies were screened based on the COCs for OU1. The results of this screening effort are presented in Table 2-7, Soil Remediation Candidate Technologies Screening, which includes the assessment of effectiveness, implementability, and relative cost of each identified technology. The table also notes whether the technology is to be retained and, if not, the specific reason for elimination.

It should be noted that the screening presented in these tables is the screening of technologies as primary remedial mechanisms. However, even if a technology is eliminated as a primary remedial mechanism, it may still be a part of an overall approach.

### 2.7.2 Retained Candidate Technologies

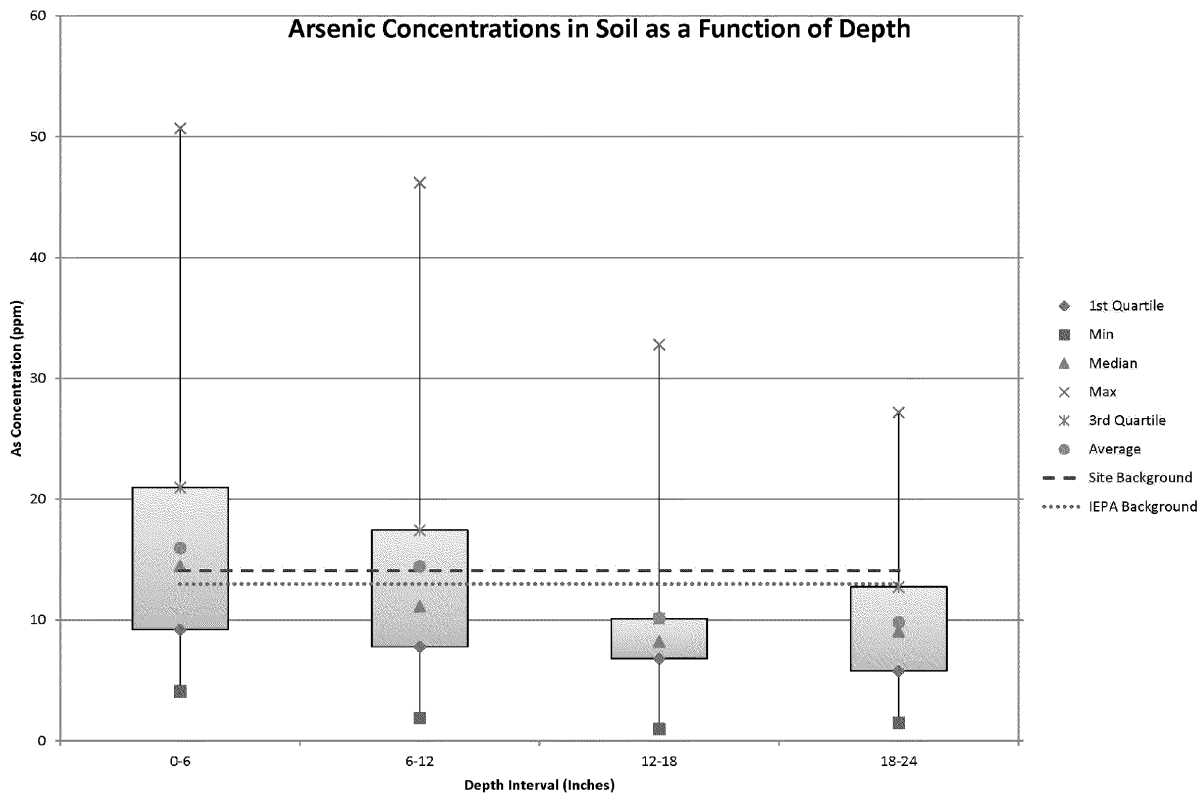
The potential remedial technologies still under consideration for mitigation of identified risk are presented in Table 2-8, Soil Retained Technologies for Risk Mitigation, which also includes comments on the potential application of each technology to OU1. The following technologies were retained.

- ☐ No Action
  - No Action
- ☐ Institutional Controls
  - Property use restrictions
  - Property access restrictions
- ☐ Removal
  - Mechanical excavation
  - Hand excavation
- ☐ Disposal
  - Off-site disposal to a RCRA Subtitle C hazardous-waste landfill
  - Off-site disposal to a RCRA Subtitle D solid-waste landfill
- ☐ Containment
  - Low-permeability cap
  - Soil cover
- ☐ *In Situ* Treatment
  - Chemical stabilization
- ☐ *Ex Situ* Treatment
  - *Ex situ* stabilization

The retained technologies listed in Table 2-8 are the building blocks used to develop the potential remedial alternatives in Section 3.0 of this FS.

## **FIGURES**

- 2-1     Arsenic Concentrations in Soil as a Function of Depth
- 2-2     Histogram of Arsenic Concentrations at OU1



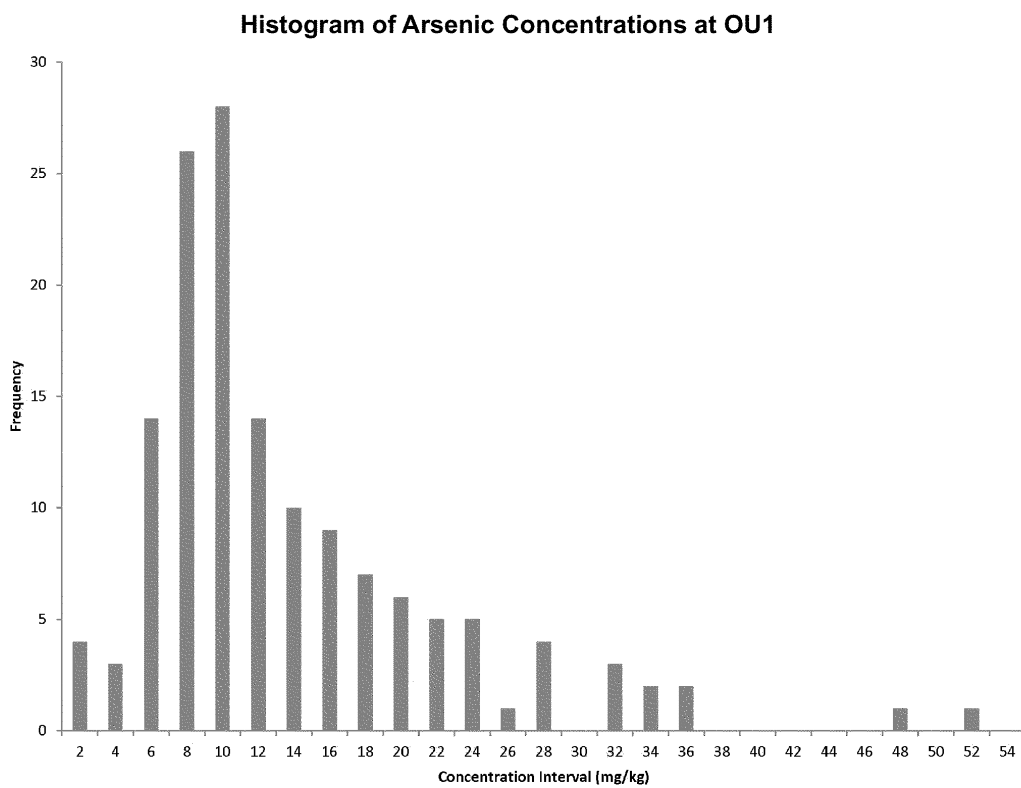
US SMELTER & LEAD REFINERY  
LAKE COUNTY, EAST CHICAGO, INDIANA



DRAFT FEASIBILITY STUDY

**FIGURE 2-1**  
**ARSENIC CONCENTRATIONS IN**  
**SOIL AS A FUNCTION OF DEPTH**

EPA REGION 5 RAC 2 | REVISION 0 | JUNE 2012

**ST** SuITRAC



	US SMELTER & LEAD REFINERY LAKE COUNTY, EAST CHICAGO, INDIANA		
	<b>DRAFT FEASIBILITY STUDY</b>		
	<b>FIGURE 2-2</b>		
	<b>HISTOGRAM OF ARSENIC CONCENTRATIONS AT OU1</b>		
EPA REGION 5 RAC 2			REVISION 0
			JUNE 2012
		<b>SulTRAC</b>	

## **TABLES**

2-1	List of Potentially Applicable or Relevant and Appropriate Requirements
2-2	Soil Remedial Action Levels
2-3	Total Estimated Number of Yards and Quadrants at OU1
2-4	Remedial Soil Area Estimates
2-5	Soil General Response Actions
2-6	Soil Candidate Technologies for Risk Mitigation
2-7	Soil Remediation Candidate Technologies Screening
2-8	Soil Retained Technologies for Risk Mitigation

**TABLE 2-1**  
**List of Potentially Applicable/Relevant and Appropriate Requirements**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable/ Relevant and Appropriate Requirements	Description	Type of ARAR	Potentially Applicable/ Relevant and Appropriate?	Comment
<b>CLEAN AIR ACT (CAA) of 1974</b>				
40 CFR 7401	The Act is intended to protect the quality of air and promote public health. Title I of the Act directed the U.S. Environmental Protection Agency (EPA) to publish national ambient air quality standards for "criteria pollutants." In addition, EPA has provided national emission standards for hazardous air pollutants under Title III of the Act. Hazardous air pollutants are also designated hazardous substances under CERCLA. The Clean Air Act amendments of 1990 greatly expanded the role of National Emission Standards for Hazardous Air Pollutants by designating 179 new hazardous air pollutants and directed EPA to attain maximum achievable control technology standards for emission sources. Such emission standards are potential ARARs if selected remedial technologies produce air emissions of regulated hazardous air pollutants.	Action- Specific	Potentially Applicable	The Act is considered an ARAR for remedies that involve creation of air emissions, such as excavation activities that might create dust. Also includes emissions rules which apply to equipment working on the project (based on date of manufacture and/or rebuild and/or overhaul).

**TABLE 2-1**  
**List of Potentially Applicable/Relevant and Appropriate Requirements**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable/ Relevant and Appropriate Requirements	Description	Type of ARAR	Potentially Applicable/ Relevant and Appropriate?	Comment
<b>FLOODPLAIN MANAGEMENT EXECUTIVE ORDER No. 11988</b>				
40 CFR Part 6, Appendix A	Requires federal agencies to evaluate the potential adverse effects associated with direct and indirect development of a floodplain. Alternatives that involve modification/construction within a floodplain may not be selected unless a determination is made that no practicable alternative exists. If no practicable alternative exists, potential harm must be minimized and action taken to restore and preserve the natural and beneficial values of the floodplain.	Location-Specific	Potentially Applicable	Determined by Grand Calumet River floodplain
<b>CLEAN WATER ACT (CWA) OF 1977</b>				
Protection of Wetlands Executive Order 11990 [40 CFR Part 6, Appendix A]	Under this Order, federal agencies are required to minimize the destruction, loss, or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. If remediation is required within wetland areas and no practical alternative exists, potential harm must be minimized and action taken to restore natural and beneficial values.	Location-Specific	To Be Considered	Determined by location of wetlands, if any, along Grand Calumet River
Federal Water Pollution Control Act Section 401: Water Quality Certification	Establishes a permit program to regulate a discharge into the navigable waters of the U.S., including wetlands.	Chemical-Specific	Relevant and Appropriate	Depends on nature of remedial action chosen.

**TABLE 2-1**  
**List of Potentially Applicable/Relevant and Appropriate Requirements**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable/ Relevant and Appropriate Requirements	Description	Type of ARAR	Potentially Applicable/ Relevant and Appropriate?	Comment
National Pollutant Discharge Elimination System (NPDES) 33 U.S.C. §§1251-1387 Clean Water Act NPDES Permit Program (40 CFR 122)	Regulates discharges of pollutants to navigable waters.	Action-Specific and may be Chemical-specific	Relevant and Appropriate	Depends on nature of remedial action chosen. Applies to disturbances of one acre or more of total land area and disturbances of less than one acre of land that are part of a larger common plan of development or sale if the larger common plan will ultimately disturb one or more acres of land.
<b>FISH AND WILDLIFE COORDINATION ACT</b>				
Fish and Wildlife Coordination Act; 16 U.S.C. §§661 et seq. 16 USC 742a 16 USC 2901 40 CFR 6.302 50 CFR 402	Actions that affect species/habitat require consultation with U.S. Department of Interior, U.S. Fish and Wildlife Service, and National Marine Fisheries Service, and/or state agencies, as appropriate, to ensure that proposed actions do not jeopardize the continued existence of the species or adversely modify or destroy critical habitat. The effects of water-related projects on fish and wildlife resources must be considered. Action must be taken to prevent, mitigate, or compensate for project-related damages or losses to fish and wildlife resources. Consultation with the responsible agency is also strongly recommended for on-site actions. Under 40 CFR Part 300.38, these requirements apply to all response activities under the National Contingency Plan.	Location-Specific	Potentially Applicable	

**TABLE 2-1**  
**List of Potentially Applicable/Relevant and Appropriate Requirements**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable/ Relevant and Appropriate Requirements	Description	Type of ARAR	Potentially Applicable/ Relevant and Appropriate?	Comment
<b>RESOURCE CONSERVATION AND RECOVERY ACT OF 1976</b>				
Off-Site Land Disposal Subtitle C [40 CFR 260-268]	Soil and/or sediment that is excavated for off-site disposal and constitutes a hazardous waste must be managed in accordance with the requirements of RCRA.	Action-Specific	Potentially Applicable	Depends on nature of remedial action chosen
Land Disposal Restrictions [40 CFR 268.2]	The land disposal restrictions (LDR) provide a second measure of protection from threats posed by hazardous waste disposal by ensuring that hazardous waste cannot be placed on the land until the waste meets specific treatment standards to reduce the mobility or toxicity of its hazardous constituents. Hazardous waste destined for land disposal must meet the applicable Land Disposal Regulations of 40 CFR 268.	Action-Specific and Chemical-Specific	Relevant and Appropriate	Depends on nature of remedial action chosen
Off-Site Land Disposal Subtitle D [40 CFR 258]	Criteria for Municipal Solid Waste Landfills, establishes requirements for the operation of landfills accepting non-hazardous solid waste. These requirements would be applicable to facilities used for the disposal of non-hazardous soil and/or sediment.	Action-Specific	Potentially Applicable	Depends on nature of remedial action chosen
Criteria for Municipal Solid Waste Landfills for Site Capping [40 CFR 258, Subpart F]	Provides minimum standards for cover systems at solid-waste disposal facilities.	Action-Specific	Potentially Relevant and Appropriate	Depends on nature of remedial action chosen

**TABLE 2-1**  
**List of Potentially Applicable/Relevant and Appropriate Requirements**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable/ Relevant and Appropriate Requirements	Description	Type of ARAR	Potentially Applicable/ Relevant and Appropriate?	Comment
Definition of a hazardous waste [40 CFR 261.3(d) and 329 IAC 3.1]	For all hazardous waste related equipment, remove or decontaminate all hazardous waste residues, contaminated containment components, contaminated soils, and structures and equipment contaminated with waste, and manage them as hazardous unless 40 CFR 261.3(d) applies	Chemical-specific	Relevant and Appropriate	
Hazardous waste determination [40 CFR 262.11 and 329 IAC 3.1-6]	Requires that a proper hazardous waste determination must be made on all wastes generated from remedial actions.	Chemical-specific	Relevant and Appropriate	
Pre-Transportation Requirements [40 CFR 262.30, 262.31, 262.32, and 262.33 and 329 IAC 3.1-7 and 329 IAC 3.1-8]	All hazardous waste must be properly packaged, with labels, markings, and placards, prior to transport.	Chemical-specific	Relevant and Appropriate	
Standards applicable to the generators of hazardous waste - The manifest [40 CFR 262, Subpart B and 329 IAC 3.1-7 and 329 IAC 3.1-8]	Hazardous waste stored onsite in containers for greater than 90 days shall be managed in accordance with 40 CFR 262, Subpart B (329 IAC 3.1-7 and 329 IAC 3.1-8).	Chemical-specific	Potentially Applicable	

**TABLE 2-1**  
**List of Potentially Applicable/Relevant and Appropriate Requirements**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable/ Relevant and Appropriate Requirements	Description	Type of ARAR	Potentially Applicable/ Relevant and Appropriate?	Comment
Standards applicable to the generators of hazardous waste - The manifest [40 CFR 262, Subpart B and 329 IAC 3.1-7 and 329 IAC 3.1-8]	Hazardous waste must be manifested as such for transport to a permitted treatment, storage, or disposal facility (TSDF)	Chemical-specific	Relevant and Appropriate	
Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities - Waste piles [40 CFR 264, Subpart L]	Any excavated contaminated soils must not be placed back on the ground so as to create a waste pile. Covered rolloffs may be used.	Chemical-specific	Relevant and Appropriate	
Use and management of containers [40 CFR 265, Subpart I and 329 IAC 3.1-10]	Hazardous waste stored onsite in containers for 90 days or less shall be managed in accordance with the standards of 40 CFR 265, Subpart I (329 IAC 3.1-10).	Chemical-specific	Relevant and Appropriate	
<b>ENDANGERED SPECIES ACT</b>				
Endangered Species Act [16 USC 1531]; 50 CFR 200	Requires that federal agencies ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or adversely modify critical habitat.	Location- Specific	Potentially applicable	No endangered species are known to be present on the site that would be affected by remedial actions.

**TABLE 2-1**  
**List of Potentially Applicable/Relevant and Appropriate Requirements**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable/ Relevant and Appropriate Requirements	Description	Type of ARAR	Potentially Applicable/ Relevant and Appropriate?	Comment
<b>NATURAL HISTORIC PRESERVATION ACT</b>				
National Historic Preservation Act [16 USC 661 et seq.] 36 CFR Part 65	Establishes procedures to provide for preservation of scientific, historical, and archaeological data that might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program. If scientific, historical, or archaeological artifacts are discovered at the site, work in the area of the site affected by such discovery will be halted pending a completion of any data recovery and preservation activities required pursuant to the act and any implementing regulations.	Location- Specific	Potentially applicable	No part of the USS Lead Residential Area is listed on the national register of historic places. Potentially applicable during remedial activities if scientific, historic, or archaeological artifacts are identified during implementation of the remedy.
<b>DEPARTMENT OF TRANSPORTATION</b>				
Requirements for the Transport of Hazardous Materials [40 CFR 172]	Transportation of hazardous materials on public roadways must comply with the requirements.	Action-Specific	Potentially Applicable	Depends on nature of remedial action chosen
<b>OTHER FEDERAL GUIDELINES TO BE CONSIDERED</b>				
Integrated Risk Information System (IRIS)	Risk reference doses (RfD) are estimates of daily exposure levels that are unlikely to cause adverse non-carcinogenic health effects over a lifetime. Cancer Slope Factors (CSF) are used to compute the incremental cancer risk from exposure to site contaminants and represent the most up-to-date information on cancer risk from EPA's Carcinogen Assessment Group.	Chemical- Specific	To Be Considered	

**TABLE 2-1**  
**List of Potentially Applicable/Relevant and Appropriate Requirements**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable/ Relevant and Appropriate Requirements	Description	Type of ARAR	Potentially Applicable/ Relevant and Appropriate?	Comment
EPA Regional Screening Levels	EPA Regional Screening Levels (RSLs and associated guidance necessary to calculate them) are risk-based tools for evaluating and cleaning up contaminated sites. The RSLs represent Agency guidelines and are not legally enforceable standards.	Chemical-Specific	To Be Considered	
Occupational Safety and Health Act [29 CFR 61]	The Act was passed in 1970 to ensure worker safety on the job. Worker safety at hazardous waste sites is addressed under 29 CFR 1910.120: Hazardous Waste Operations and Emergency Response. General worker safety is covered elsewhere within the law.	Action-specific	Potentially Applicable	The Act is considered an ARAR for construction activities performed during the implementation of remedies. Depends on nature of remedial action chosen.
<b>INDIANA ADMINISTRATIVE CODE</b>				
Indiana Solid Waste Rules (IAC Title 329)	This law applies to remedies that involve off-site disposal of materials typically involved with excavations. Contaminated soils or wastes that are excavated for off-site disposal would be tested for hazardous waste characteristics and requirements of the Rules would be followed if hazardous waste is found.	Action - Specific	Potentially Relevant and Appropriate	Depends on nature of remedial action chosen.
Generator Responsibilities for Waste Information (329 IAC 10-7.2-1)	Requires all wastes undergo a waste determination, and if found to be nonhazardous, be disposed of in a permitted solid waste disposal facility.	Chemical-specific	Relevant and Appropriate	
Indiana Air Pollution Control Regulations (IAC Title 326)	This law applies to the regulation air emissions, for activities such as excavation, that have the potential to create dust.	Action-Specific	Potentially Relevant and Appropriate	Depends on nature of remedial action chosen.

**TABLE 2-1**  
**List of Potentially Applicable/Relevant and Appropriate Requirements**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable/ Relevant and Appropriate Requirements	Description	Type of ARAR	Potentially Applicable/ Relevant and Appropriate?	Comment
Rule 4, Fugitive Dust Emission (326 IAC 6-4-1[4])	Rule 4 establishes that visible fugitive dust must not escape beyond the property line or boundaries of the property, right-of-way, or easement on which the source is located.	Location/Action-specific	Relevant and Appropriate	
Motor vehicle fugitive dust sources (326 IAC 6-4-4)	No vehicle driven on any public right of way may allow its contents to escape and form fugitive dust.	Action-Specific	Relevant and Appropriate	
Ground Water Quality Standards (327 IAC 2-11-2(e))	States that no person shall cause the groundwater in a drinking water supply well to have contaminant concentration that results in an exceedance of numeric criteria contained within the rule for drinking water class groundwater, creates a condition that is injurious to human health, creates an exceedance of specific indicator criteria levels contained within the rule, or renders the well unusable for normal domestic use.	Chemical-specific	Potentially Applicable	Groundwater is being considered under future actions at OU2.

**TABLE 2-1**  
**List of Potentially Applicable/Relevant and Appropriate Requirements**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable/ Relevant and Appropriate Requirements	Description	Type of ARAR	Potentially Applicable/ Relevant and Appropriate?	Comment
Voluntary Remediation of Hazardous Substances and Petroleum (Indiana Code [IC] 13-25-5)	IC 13-25-5 established the Voluntary Remediation Program in 1993 and gave the IDEM the authority to establish guidelines for voluntary site closure. Under this authority IDEM developed a non-rule policy document, the Risk Integrated System of Closure (RISC), to guide site closures within the authority of IDEM's remediation programs. This guidance document does not have the effect of law.	Chemical-specific	To Be Considered	The RISC document provides a methodology for establishing remedial goals and determining that remediation has been achieved. The RISC policy does not apply to Superfund sites, but does apply to remedial sites under several state programs, including the state version of RCRA, the state Leaking Underground Storage Tank program, the State Cleanup Program (state equivalent of the Federal Superfund Program) and the Voluntary Remediation Program.
Contained in Policy Guidance for RCRA	Guidance document on management of remediation waste. This guidance document does not have the effect of law.	Chemical-specific	To Be Considered	

**TABLE 2-1**  
**List of Potentially Applicable/Relevant and Appropriate Requirements**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable/ Relevant and Appropriate Requirements	Description	Type of ARAR	Potentially Applicable/ Relevant and Appropriate?	Comment
<b>CITY OF EAST CHICAGO</b>				
Ordinance for the Control of Stormwater	Regulates the capture and conveyance of stormwater runoff in order to mitigate the damaging effects of stormwater runoff; correct stormwater collection and conveyance problems; protect public health, welfare, safety, and the environment, and fund the activities of stormwater management including design, planning, regulation, education, coordination, construction, operation, maintenance, inspection, and enforcement activities. Based on CWA NPDES regulations.	Action-specific	Relevant and Appropriate	Depends on nature of remedial action chosen. Applies to disturbances of one acre or more of total land area and disturbances of less than one acre of land that are part of a larger common plan of development or sale if the larger common plan will ultimately disturb one or more acres of land.

Notes

ARAR	Applicable/Relevant and Appropriate Requirements	LDR	Land disposal restrictions
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	NPDES	National Pollutant Discharge Elimination System
CFR	<i>Code of Federal Regulations</i>	RCRA	Resource Conservation and Recovery Act
CSF	Cancer Slope Factor	RISC	Risk Integrated System of Closure
CWA	Clean Water Act	RfD	Risk Reference Dose
EPA	U.S. Environmental Protection Agency	RSL	Regional Screening Level
IAC	Indiana Administrative Code	SDWA	Safe Drinking Water Act
IC	Indiana Code	TSDF	Treatment, storage, or disposal facility
IDEM	Indiana Department of Environmental Management		
IRIS	Integrated Risk Information System		

**TABLE 2-2**  
**Remedial Action Levels for Soil at OU-1**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Analyte Group	Analyte Name	Units	OU-1 Soil RAL	Reference
Metals	Arsenic	mg/kg	26.4	UTL
	Lead	mg/kg	400 (Residential) 800 (Industrial)	RSL

Notes:

mg/kg	Milligram per kilogram
RAL	Remedial action level
RSL	Regional screening level
UTL	Upper threshold limit

**TABLE 2-3**  
**Total Estimated Number of Yards and Quadrants at OU-1**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

	Properties	Yards
<b>Eastern Area</b>		
Residential	490	974
Commercial/Industrial	13	52
Park/Church	3	12
Right-of-Way/Easement	11	44
<i>Eastern total</i>	<i>517</i>	<i>1082</i>
<b>Southwestern Area</b>		
Residential	345	666
Commercial/Industrial	13	52
Park/Church	3	12
Right-of-Way/Easement	2	8
<i>Southwestern total</i>	<i>363</i>	<i>738</i>
<b>Northwestern Area</b>		
Residential	339	674
Commercial/Industrial	43	172
Park/Church	5	20
Right-of-Way/Easement	4	16
<i>Northwestern total</i>	<i>391</i>	<i>882</i>
<b>TOTAL</b>	<b>1271</b>	<b>2702</b>

**TABLE 2-4**  
**Remedial Soil Area Estimates**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

East Chicago, Indiana								
	No. Yards in OU-1	Property type	Percent (%) that exceed lead or arsenic RAL <sup>1</sup>	No. yards that require remediation	No. properties that require remediation	Average yard size (sq ft)	Total area requiring remediation (sq ft)	Total area by property type (sq ft)
Eastern Area								
Front/back	974	Residential	41%	397	199	900	357,300	357,300
Park/school/church	12	Non- residential	67%	8	2	10,026	80,208	102,688
Industrial/commercial/easement	96		10%	10	3	2,248	22,480	
Southwestern Area								
Front/back	666	Residential	66%	437	219	1,567	684,779	684,779
Park/school/church	12	Non- residential	100%	12	3	8,196	98,352	118,781
Industrial/commercial/easement	60		52%	31	8	659	20,429	
Northwestern Area								
Front/back	674	Residential	51%	343	172	900	308,700	308,700
Park/school/church	20	Non- residential	15%	3	1	4,345	13,035	35,667
Industrial/commercial/easement	188		12%	23	6	984	22,632	
TOTAL	2,702			1,264	613		1,607,915	

Notes

RAL Remedial Action Level

1. Based on Final RI results (SulTRAC 2012). See Appendix A, Table A-1 for details

**TABLE 2-5**  
**Soil General Response Actions**  
**USS Lead Site OU-1**  
**East Chicago, Indiana**

General Response Actions	Description/Comments
No Action	Under the CERCLA-mandated no-action alternative, no action will be taken at the Site with respect to remediation.
Institutional Controls	This GRA includes administrative mechanisms such as deed restrictions and use designations as well as physical actions such as posting and fencing to restrict Site access and use.
Removal	This GRA involves the excavation of impacted soils.
Disposal	This GRA includes the disposal of excavated soils at an off-site facility.
Containment	This GRA generally entails capping to isolate impacted soil from human and ecological receptors.
<i>In Situ</i> Treatment	This GRA includes remedies that involve implemented processes to contain, destroy, or otherwise reduce the bioavailability or toxicity of contaminants in soil. This GRA may involve physical, chemical, or biological processes. Treatment to be conducted onsite, <i>in situ</i> .
<i>Ex Situ</i> Treatment	This GRA includes remedies that involve implemented processes to contain, destroy, or otherwise reduce the bioavailability or toxicity of contaminants in soil. This GRA may involve physical, chemical, or biological processes. Treatment may be conducted at on- or off-site facilities.

Notes:  
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act  
GRA General response action

TABLE 2-6  
Soil Candidate Technologies for Risk Mitigation  
USS Lead Site, OU-1  
East Chicago, Indiana

Candidate Technology	Description	Comments/Notes
No Action		
No action	CERCLA-mandated alternative of no action taken to mitigate risk	<input type="checkbox"/> CERCLA-mandated
Institutional Controls		
Property use restrictions	Stipulated limits on property use; can include posting no access and limiting use to non-intrusive activities (such as no gardens) or specific types of use (such as non-residential use); may include deed restrictions	<input type="checkbox"/> May also be used in conjunction with ongoing, long-term remedies that will leave behind residual contamination for an extended period of time <input type="checkbox"/> May not be suitable within residential properties <sup>1</sup>
Property access restrictions	Restrictions to prevent property access; can be through posting or fencing	<input type="checkbox"/> May also be used in conjunction with ongoing, long-term remedies that will leave behind residual contamination for an extended period of time <input type="checkbox"/> May not be suitable within residential properties <sup>1</sup>
Removal		
Mechanical excavation	Excavation of impacted soils using earth-digging or -moving construction equipment	<input type="checkbox"/> May be used in conjunction with capping, disposal, and <i>ex-situ</i> treatment
Hand excavation	Excavation of impacted soils using hand-digging equipment	<input type="checkbox"/> May be used in conjunction with capping, disposal, and <i>ex-situ</i> treatment
Disposal		
Off-site disposal to RCRA Subtitle C Hazardous Waste Landfill	Solid hazardous wastes are permanently disposed of in an off-site RCRA-permitted landfill.	<input type="checkbox"/> May be used in conjunction with excavation <input type="checkbox"/> Applicable to hazardous and non-hazardous wastes <input type="checkbox"/> Soil requires pre-treatment in accordance with land disposal restrictions <input type="checkbox"/> Required when TCLP levels exceed the allowable concentrations to non-hazardous landfills
Off-site disposal to a RCRA Subtitle D Solid Waste Landfill	Solid nonhazardous wastes are permanently disposed of in an off-site solid waste landfill.	<input type="checkbox"/> May be used in conjunction with excavation and <i>ex-situ</i> treatment <input type="checkbox"/> Soil may require pre-treatment in accordance with land disposal restrictions <input type="checkbox"/> Applicable to non-hazardous wastes only
Containment		
Low permeability cap	Installation of a low-permeability cap such as a synthetic liner, paving, or a designed clay layer	<input type="checkbox"/> Provides isolation, and retards groundwater infiltration <input type="checkbox"/> Can limit future site re-development <input type="checkbox"/> May be used in conjunction with excavation of hot-spot soils <input type="checkbox"/> Inhibits revegetation <input type="checkbox"/> Anticipate minimal acceptance by community <input type="checkbox"/> Requires long term O&M
Soil cover	Installation of an engineered soil cover	<input type="checkbox"/> Provides isolation <input type="checkbox"/> Can limit future site re-development <input type="checkbox"/> May not be suitable within residential properties <sup>1</sup> <input type="checkbox"/> May require institutional controls <input type="checkbox"/> Conducive to revegetation <input type="checkbox"/> Minimum of 12" of cover required by <i>Superfund Lead-Contaminated Residential Sites Handbook</i> (EPA 2003) <input type="checkbox"/> Requires long term O&M

TABLE 2-6  
Soil Candidate Technologies for Risk Mitigation  
USS Lead Site, OU-1  
East Chicago, Indiana

Candidate Technology	Description	Comments/Notes
<i>In Situ Treatment</i>		
Chemical stabilization	Stabilization is accomplished by reducing the contaminant toxicity through decreasing contaminant mobility, solubility, and/or bioavailability. Stabilization occurs through the application of soil amendments such as phosphates (i.e., ground fish bones), iron oxyhydroxides, or limestone. Reduction of toxicity is achieved and maintained by reducing the bioavailability of the contaminant. In-situ application can be accomplished with standard soil mixing practices. In-situ stabilization avoids additional handling during treatment and typically allows resultant materials to be left in place.	<div><div></div><div>Generally considered for metals and other inorganic materials and compounds</div><div></div><div>Requires distribution of reagents throughout treatment zone</div><div></div><div>Generally requires bench-scale and pilot testing</div><div></div><div>Can limit future site re-development</div><div></div><div>Long term effectiveness of some amendments (e.g., ground fish bones) has not been proven</div><div></div><div>Increased volume of material can result from treatment</div></div>
Vitrification	Subsurface heating to a temperature capable of solidifying soil matrix, thereby reducing contaminant mobility	<div><div></div><div>Generally considered for metals and inorganic compounds, also applicable for organic compounds</div><div></div><div>Requires application of heat throughout treatment zone</div><div></div><div>Generally requires bench-scale and pilot testing</div><div></div><div>Not suitable within residential properties<sup>2</sup></div></div>
Bioleaching	Extraction of metals from soil particles using bacteria conveyed in water; generally involves bacteria sulfides in sulfide-bound metals, thereby releasing metals to be absorbed into conveyance water and removed from the Site; an emerging technology from the metal-ore processing field	<div><div></div><div>Considered for metals; however, different solutions may be required for lead and arsenic treatment</div><div></div><div>Not effective on organic compounds</div><div></div><div>Requires circulation of bioleaching mixture throughout treatment zone</div><div></div><div>Emerging technology for remediation</div><div></div><div>Requires bench-scale and pilot testing</div><div></div><div>Not suitable within residential properties<sup>3</sup></div></div>
Biosolids remediation	Application of Class 1 biosolids to surface of impacted area; biosolids are then mixed or tilled into soil to approximate depth of 3 feet; biosolids effectively bind metals, reducing contaminant toxicity and bioavailability; emerging technology being used for reclamation of mine areas	<div><div></div><div>Generally considered effective for metals, not considered effective for organic compounds</div><div></div><div>Requires application throughout impacted area</div><div></div><div>Likely requires compliance with biosolids land application regulations that could be problematic for areas close to the Grand Calumet River</div><div></div><div>Emerging technology for remediation</div><div></div><div>Requires bench-scale and pilot testing</div><div></div><div>Not suitable within residential properties<sup>3</sup></div></div>
Phytoremediation	Phytoremediation is a set of processes that uses plants to remove inorganics from the shallow soil and transfer them to the biomass. It is preferred that metal-accumulating plants accumulate the metals in the shoots (aboveground biomass) rather than the roots for ease in harvesting and repeated removal of accumulated metals.	<div><div></div><div>Requires harvesting of plants and disposal</div><div></div><div>Applicable to metals remediation, particularly lead, limited success for arsenic and PAHs</div><div></div><div>Climatic or seasonal conditions may interfere or inhibit plant growth, slow remediation efforts, or increase length of treatment period.</div><div></div><div>Effectiveness depends on affinity of plants to uptake targeted contaminants</div><div></div><div>Not suitable within residential properties<sup>4</sup></div><div></div><div>Not recommended by the <i>Superfund Lead-Contaminated Residential Sites Handbook</i> (EPA 2003)</div></div>

TABLE 2-6  
Soil Candidate Technologies for Risk Mitigation  
USS Lead Site, OU-1  
East Chicago, Indiana

Candidate Technology	Description	Comments/Notes
<b>Ex Situ Treatment</b>		
Soil washing	Soil washing is a water-based process for scrubbing soil <i>ex situ</i> to remove contaminants. The process removes contaminants from soil in one of two ways: (1) by dissolving or suspending contaminants in a wash solution (can be sustained by chemical manipulation of pH) or (2) by concentrating contaminants into a smaller volume of soil through particle size separation, gravity separation, and attrition.	<div><div></div><div>Generally considered for metals and inorganic compounds</div><div></div><div>Different solutions required for lead, arsenic, and PAH removal</div><div></div><div>Requires capturing, treating, and disposing of wash water</div><div></div><div>Generally requires bench-scale and pilot testing</div><div></div><div>Soil would be treated off site, and either returned to the area excavated or disposed of offsite</div></div>
Pyrometallurgical recovery	Uses elevated temperature extraction and processing to remove metals from contaminated soils	<div><div></div><div>Soil containing lead and arsenic may require pretreatment</div><div></div><div>Generally produces metal-bearing waste slag that requires disposal</div><div></div><div>Generally requires bench-scale and pilot testing</div><div></div><div>Soil would be treated offsite, and either returned to the area excavated or disposed of offsite</div></div>
Ex situ solidification/stabilization	Contaminants either physically bound within a stabilized mass (solidification), or chemical stabilized to reduce mobility (stabilization)	<div><div></div><div>Creates a crystalline, glassy, or polymeric framework around the waste</div><div></div><div>Effective at reducing contaminant mobility and passing TCLP testing</div><div></div><div>Not suitable for reuse as fill material at residential properties</div><div></div><div>May be used in conjunction with capping, excavation, and disposal</div></div>
Chemical Extraction	Hydrochloric acid is used to extract heavy metals from soil in an acid extraction process. The soil and acid are mixed in a closed extraction unit, dissolving the inorganic contaminants into the acid. When extraction is complete (10 to 40 minutes), the soil is rinsed with water to remove the entrained acid and metals. The clean soil is then dewatered and mixed with lime and fertilizer to neutralize any residual acid.	<div><div></div><div>Generally considered for metals and inorganic compounds, less effective for organic compounds</div><div></div><div>Generally requires bench-scale and pilot testing</div><div></div><div>Soil would be treated offsite, and either returned to the area excavated or disposed of offsite</div></div>

- Notes:
- CERCLA

Comprehensive Environmental Response, Compensation, and Liability Act
- O&M

Operation and maintenance
- PAH

Polycyclic aromatic hydrocarbons
- RCRA

Resource Conservation and Recovery Act
- TCLP

Toxicity Characteristic Leaching Procedure
1.

This technology would limit the homeowner or tenants use of their property by creating property use and access restrictions
2.

Vitrification would create a solid, hardened, glass-like material out of the soil material, which would limit the residents use of their property.
3.

Bioremediation and biosolids remediation includes the application of biological material (bacteria and biosolids, respectively) to the soil for treatment, which could pose health risks to residents.
4.

Phytoremediation has a long treatment-time frame that would leave soil contaminants accessible to residents for up to a few growing seasons before the contaminants are taken up by the plants. Furthermore, the plants bioaccumulate the metals and then require disposal as a contaminated material.

TABLE 2-7  
Soil Remediation Candidate Technologies Screening  
USS Lead Site, OU-1  
East Chicago, Indiana

Technology	Effectiveness	Implementability	Relative Cost <sup>1</sup>	Retained?	Reason for Elimination
No Action					
No action	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Not effective at reducing contamination.</div> <div><input type="checkbox"/> Not effective with respect to risk reduction.</div>	Easily implementable	Low	Yes	NA
Institutional Controls					
Property use restrictions	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Not effective at reducing contamination.</div> <div><input type="checkbox"/> Effective at reducing human risk.</div>	Easily implementable	Low	Yes	NA
Property access restrictions	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Not effective at reducing contamination.</div> <div><input type="checkbox"/> Effective at reducing human risk.</div>	Easily implementable	Low	Yes	NA
Removal					
Mechanical excavation	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Not effective at reducing overall volume of contamination; excavation and off-site disposal transfer contamination to a more secure location.</div> <div><input type="checkbox"/> Effective with respect to risk reduction.</div>	Easily implementable	Moderate	Yes	NA
Hand excavation	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Not effective at reducing overall volume of contamination; excavation and off-site disposal transfer contamination to a more secure location.</div> <div><input type="checkbox"/> Effective with respect to risk reduction.</div>	Easily implementable	Moderate	Yes	NA
Disposal					
Off-site disposal to RCRA Subtitle C Hazardous Waste Landfill	<div><input type="checkbox"/> Capable of handling volume of soil</div> <div><input type="checkbox"/> Not effective at reducing contamination; excavation and off-site disposal transfers contamination to a more secure location.</div> <div><input type="checkbox"/> Effective with respect to risk reduction</div>	Implementable	High	Yes	NA
Disposal					
Off-site disposal to RCRA Subtitle D Solid Waste Landfill	<div><input type="checkbox"/> Capable of handling volume of soil</div> <div><input type="checkbox"/> Not effective at reducing contamination; excavation and off-site disposal transfers contamination to a more secure location.</div> <div><input type="checkbox"/> Effective with respect to risk reduction</div>	Implementable	Moderate	Yes	NA
Containment					
Low-permeability cover	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Not effective at reducing contamination.</div> <div><input type="checkbox"/> Effective with respect to risk reduction</div> <div><input type="checkbox"/> O&amp;M required to maintain effectiveness</div>	Difficult to Implement	High	No	Technology has a high cost and is not suitable for use in residential areas.

TABLE 2-7 Soil Remediation Candidate Technologies Screening USS Lead Site, OU-1 East Chicago, Indiana					
Technology	Effectiveness	Implementability	Relative Cost <sup>1</sup>	Retained?	Reason for Elimination
Soil cover	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Not effective at reducing contamination.</div> <div><input type="checkbox"/> Effective with respect to risk reduction</div> <div><input type="checkbox"/> O&amp;M required to maintain effectiveness</div>	Easily implementable	Low	Yes	NA
<b><i>In-situ Treatment</i></b>					
Chemical stabilization	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Effective at reducing contamination.</div> <div><input type="checkbox"/> Effective with respect to risk reduction.</div>	Difficult to Implement	Moderate	Yes	NA
Vitrification	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Can be effective at reducing contamination, but only if soil is adequately exposed to treatment process.</div> <div><input type="checkbox"/> Effective with respect to risk reduction.</div>	Difficult to Implement	High	No	Technology has a very high cost and the byproduct will prevent future site redevelopment.
Bioleaching	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Effective at reducing contamination</div> <div><input type="checkbox"/> Not definitively effective with respect to risk reduction.</div> <div><input type="checkbox"/> Must be combined with groundwater collection method to capture leaching metals.</div>	Difficult to Implement	Moderate	No	Range of microorganisms required to address multiple contaminants in subsurface. Extensive pilot testing would be required to design. Uncertainty with regard to risk reduction. Groundwater is being considered under a separate OU.
Biosolids remediation	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Effective at reducing contamination</div> <div><input type="checkbox"/> Not effective with respect to risk reduction.</div>	Difficult to Implement	Moderate	No	Technology is not suitable for use in residential areas.
Phytoremediation	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Generally effective at reducing surface level metals contamination only, not effective at reducing subsurface or organic contamination.</div> <div><input type="checkbox"/> Not definitively effective with respect to risk reduction.</div>	Implementable	Low	No	According to the <i>Superfund Lead-Contaminated Residential Sites Handbook</i> , phytoremediation is not currently an appropriate technology for residential lead cleanups due to several factors: (1) the lead concentrations at many residential sites are not within the optimal performance range for the plants; (2) the plants may concentrate lower-level lead contamination and present an increased disposal cost if the plants fail the TCLP test, but the un-remediated yard soil does not fail; (3) the length of time required for remediation; (4) the potential conflicts with local regulations pertaining to yard maintenance; and (5) the depth of remediation achieved may be inadequate (EPA 2003).
<b><i>Ex-situ Treatment</i></b>					
Soil washing	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Effective at reducing contamination.</div> <div><input type="checkbox"/> Effective with respect to risk reduction.</div>	Implementable	Moderate	No	Range of washing solutions required to address multiple contaminants. Extensive pilot testing would be required to design. Uncertainty with regard to risk reduction. Would still require on-site consolidation or off-site disposal.
Pyrometallurgical recovery	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Effective at reducing contamination.</div> <div><input type="checkbox"/> Effective with respect to risk reduction.</div>	Difficult to Implement	High	No	Metals in soil concentrations are likely too low to make metals recovery worthwhile. Technology has high cost and is very difficult to implement; other <i>ex situ</i> treatments more effective, easier to implement, and less expensive.

TABLE 2-7  
Soil Remediation Candidate Technologies Screening  
USS Lead Site, OU-1  
East Chicago, Indiana

Technology	Effectiveness	Implementability	Relative Cost <sup>1</sup>	Retained?	Reason for Elimination
<i>Ex situ</i> solidification/ stabilization	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Effective at reducing contamination.</div> <div><input type="checkbox"/> Effective with respect to risk reduction.</div>	Implementable	Moderate	Yes	NA
Chemical extraction	<div><input type="checkbox"/> Capable of handling volume of soil.</div> <div><input type="checkbox"/> Effective at reducing contamination.</div> <div><input type="checkbox"/> Effective with respect to risk reduction.</div>	Implementable	High	No	Range of extraction solutions required to address multiple contaminants, less effective for organic contamination. Extensive pilot testing would be required to design. Would still require on-site consolidation or off-site disposal.

Notes:  
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act  
O&M Operation and maintenance  
NA Not Applicable  
RCRA Resource Conservation and Recovery Act

1. The relative costs presented are based on professional engineering judgment of typical applications of the technology and guidance documents such as the Handbook (EPA 2003), EPA’s CLU-IN website (<http://clu-in.org>), and the Federal Remediation Technologies Roundtable (FRTR) Screening Matrix and Reference Guide, Version 4 (FRTR 2007).

**TABLE 2-8**  
**Soil Retained Technologies for Risk Mitigation**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

General Response Action	Candidate Technology	Comments
No Action	No Action	<input type="checkbox"/> CERCLA-mandated
Institutional Controls	Property use restrictions	<input type="checkbox"/> May be used in conjunction with ongoing, long-term remedies that will leave behind residual contamination for an extended period of time <input type="checkbox"/> Limited effectiveness if used alone
	Property access restrictions	<input type="checkbox"/> May be used in conjunction with ongoing, long-term remedies that will leave behind residual contamination for an extended period of time <input type="checkbox"/> Limited effectiveness if used alone
Excavation	Mechanical excavation	<input type="checkbox"/> Likely will be used in conjunction with disposal at Subtitle C or Subtitle D Landfill <input type="checkbox"/> Will be used in conjunction with other technologies <input type="checkbox"/> Likely used in conjunction with hand excavation
	Hand excavation	<input type="checkbox"/> Likely will be used in conjunction with disposal at Subtitle C or Subtitle D Landfill <input type="checkbox"/> Will be used in conjunction with other technologies <input type="checkbox"/> Likely used in conjunction with hand excavation
Disposal	Off-site disposal to RCRA Subtitle C Hazardous Waste Landfill	<input type="checkbox"/> May be used in conjunction with excavation <input type="checkbox"/> May be used in conjunction with <i>ex situ</i> treatment to address soil exceeding TCLP disposal criteria, as required
	Off-site disposal to RCRA Subtitle D Solid Waste Landfill	<input type="checkbox"/> May be used in conjunction with excavation <input type="checkbox"/> May be used in conjunction with <i>ex situ</i> treatment to address soil exceeding TCLP disposal criteria, as required

**TABLE 2-8**  
**Soil Retained Technologies for Risk Mitigation**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

General Response Action	Candidate Technology	Comments
<b>Containment</b>	Soil cover	<ul style="list-style-type: none"> <li><input type="checkbox"/> Provides some isolation</li> <li><input type="checkbox"/> Can limit future Site re-development</li> <li><input type="checkbox"/> Conducive to revegetation</li> <li><input type="checkbox"/> Minimum of 12" of cover required by <i>Superfund Lead-Contaminated Residential Sites Handbook</i> (EPA 2003a)</li> </ul>
<b><i>In Situ</i> Treatment</b>	Chemical Stabilization	<ul style="list-style-type: none"> <li><input type="checkbox"/> May be used in conjunction with Institutional Controls</li> <li><input type="checkbox"/> Can limit future Site re-development</li> </ul>
<b><i>Ex Situ</i> Treatment</b>	<i>Ex Situ</i> Stabilization	<ul style="list-style-type: none"> <li><input type="checkbox"/> To be used in conjunction with excavation and disposal at Subtitle C or Subtitle D Landfill</li> </ul>

Notes

CERCLA      Comprehensive Environmental Response, Compensation, and Liability Act  
RCRA        Resource Conservation and Recovery Act  
TCLP        Toxicity Characteristic Leaching Procedure

### 3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

This section presents the development and screening of the remedial alternatives and is organized as follows: the Introduction (Section 3.1), the Remedial Alternative Development (Section 3.2), and then the Remedial Alternative Screening (Section 3.3).

#### 3.1 Introduction

Technically feasible technologies that are retained after screening in Section 2.7 above were combined to form remedial alternatives that may be applicable to OU1, the contaminated soil media, and the COCs. Technologies potentially capable of attaining the proposed RAO are assembled, either singly or in combination, into remedial alternatives. The remedial alternatives that have been assembled for soil at OU1 are detailed below in Section 3.2.

#### 3.2 Remedial Alternative Development

Remedial alternatives for soil must address the potential for ingestion, direct contact, and inhalation risks to site users. The following sections discuss the remedial alternatives identified based on the technologies that have passed screening for each investigation area.

The following remedial alternatives will be screened for OU1:

- ☐ **Alternative 1 – No action.** No action will be taken to mitigate risk. The NCP requires that this alternative be evaluated.
- ☐ **Alternative 2 – Institutional controls.** Implement property-use and -access restrictions limiting future property usage, and require that any excavation be done with knowledge of residual contamination such that proper precautions are taken to protect site users from exposure to COCs in soil. In accordance with CERCLA requirements, 5-year reviews will be required with this alternative, because impacted soil will be left in place.
- ☐ **Alternative 3 – On-site soil cover + Institutional controls.** This alternative involves installing a 1-foot-thick soil cap with sod or seed-, which is tied into grade along the perimeter of the yard. A visual barrier, such as orange construction fencing or landscaping fabric, will be placed over the contaminated soil and beneath the soil cover. Residual contamination will be left in place and covered with an on-site soil cover that will restrict direct contact with contaminated soil. Institutional Controls will be implemented to maintain the integrity of the soil cover for the protection of site users from exposure to COCs in soil. In accordance with CERCLA requirements, 5-year reviews will be required with this alternative, because impacted soil will be left in place.

- **Alternative 4A – Excavation of soil exceeding RALs + Off-site disposal + *Ex-situ* treatment option.** This alternative involves removing impacted soil that exceeds RALs but leaving remaining soils above the native sand in place, followed by backfilling to grade and restoring with sod or seed. Excavated soil that exceeds RALs will be disposed of at an off-site Subtitle D landfill. If necessary, *ex-situ* treatment using chemical stabilization to address soil that exceeds the toxicity characteristic (TC) regulatory threshold (as characterized by the TCLP). EPA's LDRs (40 CFR 268) require treatment of soils exceeding the TCLP limit of 5 mg/L of lead before disposal. Soil exceeding RALs will be excavated to a depth determined by pre-remedial sampling results. The maximum excavation depth will be 24 inches bgs; however, the final excavation depth may vary based on pre-remedial sampling results. Any contaminated soil below 24 inches will have a visual barrier, such as orange construction fence or landscape fabric, placed over the contaminated soil and beneath the clean backfill soil. As required to meet the LDRs, soil that exceeds TCLP will be treated *ex situ* using chemical stabilization. The chemical stabilization substance(s) will bind with the COCs to reduce COC concentrations to below the TC regulatory threshold, such that treated soil can be disposed of in a Subtitle D landfill. If the *ex-situ* soil treatment cannot reduce the necessary COC concentrations to below the TC regulatory threshold, the treated soil that exceeds the TC regulatory threshold will be disposed of in a Subtitle C landfill. Excavated soil will be replaced with clean soil to maintain the original grade and restored with sod. If any soil exceeds RALs and is left in place below 24 inches bgs, EPA will require 5-year reviews in accordance with CERCLA requirements.
- **Alternative 4B – Excavation to native sand + Off-site disposal + *Ex-situ* treatment option.** This alternative consists of removing all of the fill material at impacted yards down to the native sand followed by backfilling to grade and restoring with sod or seed. The excavated soil will be disposed at an off-site Subtitle D landfill, and, if necessary, *ex-situ* treatment of soil using chemical stabilization to address soil exceeding the TC regulatory threshold. Soil in yards that exceed the RALs will be excavated from surface grade down to the native sand soil horizon, which is estimated to be no more than 24 inches bgs, based on results of the RI. This will result in removal of lead-impacted soil. RI results indicated that the native sand beneath the fill material at the site is both clean and very easily distinguished visually. As required to meet LDRs, soil will be treated *ex situ* using chemical stabilization. The chemical stabilization substance(s) will bind with the COCs to reduce the COC concentrations to below the TC regulatory threshold, such that treated soil can be disposed of in a Subtitle D landfill. If the *ex-situ* soil treatment does not decrease the necessary constituent concentrations to below the TC regulatory threshold, the treated soil that exceeds the TC regulatory threshold will be disposed of in a Subtitle C landfill. Excavated soil will be replaced with clean soil to maintain the original grade and restored with sod or seed. This alternative will result in total removal of identified impacted soils; therefore, 5-year reviews will not be required, as none of the identified contamination will be left behind.
- **Alternative 5 – *In-situ* treatment by chemical stabilization.** This alternative involves treating the soil that exceeds RALs *in situ* through the addition of chemical amendments, such as phosphates in the form of ground-up fish bones, to immobilize lead. Stabilization is accomplished by reducing the contaminant toxicity through decreasing contaminant bioavailability. The phosphates in the ground-up fish bones bind with the metals in the soil to decrease the bioavailability of the metals. The ground fish bones can be directly mixed into the soil using

standard soil-mixing practices, such as rototilling. Institutional Controls may be implemented to address maintain the integrity of the *in-situ* treated soil for the protection of site users from exposure to COCs in soil. In accordance with CERCLA requirements, 5-year reviews will be required with this alternative, because impacted soil will be left in place.

### 3.3 Screening of Remedial Alternatives

In accordance with EPA guidance, during the FS the potential remedial alternatives identified above will be screened against three broad criteria: short- and long-term effectiveness, implementability (including technical and administrative feasibility), and relative cost (capital and O&M). The purpose of the screening evaluation is to reduce the number of alternatives chosen for a more thorough and extensive analysis, and alternatives will be evaluated more generally during the screening evaluation than during the detailed analysis (EPA 1988). Quantitative cost estimates are not developed during screening of alternatives. Rather, based on knowledge of relative costs, professional judgment is used to identify the relative cost-effectiveness of each alternative. Cost estimates will be developed later in this FS process as a part of the detailed analysis of alternatives that pass the screening process.

The alternatives developed above include options that are viable for the site; however, other similar options may prove to be more effective, easier to implement, and/or have lower relative costs. Alternatives should focus only on the most viable options for site remediation. A streamlined alternative screening is presented in Table 3-1.

In evaluating effectiveness, the “short-term” is considered to be the remedial construction and implementation period, while “long-term” begins once the remedial action is complete and RAO has been met (EPA 1989). Technical feasibility includes the ability to construct, reliably operate, and meet regulations, as well as the ability to meet the O&M, replacement, and monitoring requirements after completion of the remedial action (EPA 1989). Administrative feasibility includes the ability to obtain approvals from other agencies; the availability of treatment, storage, and disposal services; and the availability of equipment and technical expertise (EPA 1989). The objective of the cost evaluation is to eliminate from further consideration those alternatives whose costs are grossly excessive for the effectiveness they provide. Cost estimates for alternatives should be sufficiently accurate to continue to support resulting decisions when their accuracy improves beyond the screening level. The cost in the streamlined screening of alternatives evaluates the capital and O&M costs on a relative basis (EPA 1989).

The following alternatives passed the screening and will be developed further in Section 4.0, Detailed Analysis of Retained Alternatives:

**Alternative 1 – No action**

**Alternative 3 – On-site soil cover + Institutional controls**

**Alternative 4A – Excavation of soil exceeding RALs + Off-site disposal + *Ex-situ* treatment option**

**Alternative 4B – Excavation to native sand + Off-site disposal + *Ex-situ* treatment option**

Two alternatives, Alternative 2 – Institutional controls, and Alternative 5 – *In-situ* treatment by chemical stabilization, did not pass the alternative screening. Alternative 2, Institutional controls, will not meet the RAO and is therefore ineligible for selection as the remedy. The use of institutional controls only is not an effective remedy for a residential area, such as OU1. Alternative 5, Chemical stabilization, specifically the use of ground fish bones to achieve phosphate immobilization, is not proven for long-term effectiveness and few case studies are available for review. Both alternatives will not continue on to the detailed analysis of alternatives.

### **3.4 Pre-Remedial Sampling**

As noted in the conclusion of the RI (SulTRAC 2012), and as summarized in Section 1.3.6, the RI recommended that each property where access can be obtained be sampled for lead and arsenic as part of the remedial design. This section details the proposed pre-remedial sampling to be conducted at OU1 properties.

Between December 2009 and September 2010, the RI sampled 88 properties within OU1. As noted in Section 2.5, there are 1,271 properties within OU1, which means that 1,183 properties require pre-remedial sampling prior to implementing a remedial action. Pre-remedial sampling will need to be conducted in order to complete the investigation of lead- and arsenic-impacted soils and conduct waste characterization of soils with high lead concentrations. The pre-remedial sampling should take place during the beginning of the remedial design phase. All field activities should be conducted in accordance with the EPA-approved, site-specific Quality Assurance Project Plan (QAPP) which will should be written and approved prior to initiating the field work. Access agreements for proposed sample locations and possible future removal will be gathered prior to initiating the field investigation.

Each residential property should be divided into front and back yards, and non-residential properties should be divided into quadrants, as in the RI. Residential properties with a structure on the property, and non-residential properties with a total area less than 5,000 ft<sup>2</sup> with a structure on the property, should be divided into front and back yards, and a 5-point composite sample would be collected from each front yard and each back yard. Four depth-discrete 5-point composite samples should be collected from each yard, including 5-point composite samples from 0-6 inches, 6-12 inches, 12-18 inches, and 18-24 inches

bgs, in an X-shaped pattern, with one sample from each end point of the X and one sample from the center. All vacant residential lots with areas less than 5,000 ft<sup>2</sup> should be divided into two halves to correspond with front and back yards and sampled in the same manner as residential properties.

Non-residential properties (including schools, recreation areas, easements, industrial/commercial properties, etc.) should be sampled by dividing the property into four quadrants. One 5-point composite would be collected from each quadrant at 0-6 inches, 6-12 inches, 12-18 inches and 18-24 inches bgs, in an X-shaped pattern with one sample from each end point of the X and one sample from the center, for a total of 16 samples. All samples would be screened using XRF for lead and arsenic; twenty-percent (20%) of the samples should be sent offsite to a Contract Laboratory Program (CLP) laboratory for metals analysis. In addition, samples that exceed the assumed TC threshold of 2,400 mg/kg of lead during XRF screening would be sent to a non-CLP off-site laboratory for TCLP analysis.

The pre-remedial sampling results would be used in the remedial design to identify the yards that require remediation and the depth of RAL exceedances in each yard. The cost of the pre-remedial sampling is included in each retained alternative, with the exception of Alternative 1, No Action.

## TABLES

3-1 Screening of Remedial Alternatives

TABLE 3-1  
Remedial Alternative Screening Summary  
USS Lead Site, OU-1  
East Chicago, Indiana

Alternative	Effectiveness		Implementability		Cost		Retained	
	Short-term	Long-term	Technical	Administrative	Capital	O&M	Yes	No
1: No action	No construction and remediation period	Remediation not complete; does not reduce toxicity, mobility, or volume of contamination	Nothing to construct or operate	Will not achieve RAO	No capital costs associated	No O&M costs associated	<input type="checkbox"/>	
2: Institutional controls	No construction and remediation period	Required indefinitely if used alone or during remedial timeframe if used in conjunction with other alternatives; does not reduce toxicity, mobility, or volume of contamination	Nothing to construct or operate	Requires access and use restrictions; will not achieve RAO; limited approval from property owners and other entities due to residential site area	Minimal costs associated with administrative fees	O&M costs will be required reporting requirements (five year reviews, ICs, etc.)		<input type="checkbox"/>
3: On-site soil cover + Institutional controls	Provides protection by preventing direct contact with impacted soil; will require increased level of truck traffic entering and exiting the site	Requires institutional controls and long-term O&M; would limit land reuse options; does not reduce toxicity, mobility, or volume of contamination	Tying soil cover into existing grade will result in significant technical challenges	State and community, as well as property owner would need to accept impacted soil remaining onsite	Main capital costs associated with soil cover and minimal costs associated with administrative fees	O&M will be required to retain integrity of cover and reporting requirements	<input type="checkbox"/>	
4A:Excavation of soil exceeding RALs + Off-site disposal + <i>Ex situ</i> treatment option	Provides protection by physically removing soil; will require increased level of truck traffic entering and exiting the site; will require worker contact with impacted soil	If soil exceeding RALs left in place, it will require institutional controls and long-term O&M; would allow land reuse in accordance with cleanup levels; does not reduce toxicity, mobility, or volume of contamination, but soil will be physically moved to a licensed facility	Adequate capacity exists at disposal facilities; requires soil staging area nearby to load soil for off-site treatment (when required) and disposal	Requires appropriate waste manifests and documentation for transportation and disposal purposes	Main capital costs associated with excavation, hauling, treatment, disposal, and yard revegetation	O&M will not be required if impacted soil is removed from the site	<input type="checkbox"/>	
4B: Excavation to native sand + Off-site disposal + <i>Ex situ</i> treatment option	Provides protection by physically removing soil; will require increased level of truck traffic entering and exiting the site; will require worker contact with impacted soil	Will not require institutional controls and long-term O&M; would allow for unrestricted land reuse; does not reduce toxicity, mobility, or volume of contamination, but soil will be physically moved to a licensed facility	Adequate capacity exists at disposal facilities; requires soil staging area nearby to load soil for off-site treatment (when required) and disposal	Requires appropriate waste manifests and documentation for transportation and disposal purposes	Main capital costs associated with excavation, hauling, treatment, disposal, and yard revegetation	O&M will not be required if impacted soil is removed from the site	<input type="checkbox"/>	
5: <i>In situ</i> treatment by chemical stabilization	Limited effectiveness during construction period; will require increased level of truck traffic entering and exiting the site; will require worker contact with impacted soil	Will require institutional controls and long-term O&M; would reduce toxicity though treatment, does not reduce mobility, or volume; long-term effectiveness is unproven	Will require <i>in situ</i> mixing of ground-up fish bone amendment blend using rototilling; requires pilot testing of amendment blend	Requires access and use restrictions; state and community will need to accept treated soil remaining onsite	Main capital costs associated with applying ground-up fish bone amendment, yard revegetation; and minimal costs associated with administrative fees	O&M will be required to retain integrity of treated soil and reporting requirements		<input type="checkbox"/>

## 4.0 DETAILED ANALYSIS OF RETAINED ALTERNATIVES

This section presents the detailed analysis of the remaining remedial alternatives and is organized as follows: the Introduction (Section 4.1), followed by the individual Alternative Analysis (Section 4.2). Within Section 4.2, each remedial alternative is presented (for example, Alternative 1 is Section 4.2.1) and is subdivided into an alternative description (Section 4.2.1.1) and alternative assessment (Section 4.2.1.2).

### 4.1 Introduction

This section presents the detailed analysis of remedial action soil alternatives for OUI at the USS Lead Site. The detailed analysis is intended to provide decision-makers with information to aid in selecting a remedial alternative that best meets the following CERCLA requirements:

- ☐ Protects human health and the environment
- ☐ Attains ARARs (or provides grounds for invoking a waiver)
- ☐ Utilizes permanent solutions and alternative treatment technologies or resource-recovery technologies to the maximum extent practical
- ☐ Satisfies the preference for treatment that reduces toxicity, mobility, or volume of hazardous substances as a principal element
- ☐ Is cost-effective

The detailed analysis was performed in accordance with CERCLA Section 121 and EPA RI/FS Guidance (EPA 1988). The detailed analysis contains the following:

- ☐ A detailed description of each candidate remedial alternative, emphasizing the application of various component technologies
- ☐ An assessment of each alternative compared to the first seven of the nine evaluation criteria described in the NCP

The detailed descriptions provide a conceptual design for each alternative. The description of each alternative includes a discussion of limitations, assumptions, and uncertainties for each component. Remedial alternatives are then evaluated according to the first seven of the nine NCP evaluation criteria. The nine criteria can be subdivided into three categories: threshold criteria, primary balancing criteria, and modifying criteria. The **threshold criteria** (overall protection of human health and the environment; compliance with ARARs) relate to statutory requirements that each alternative must satisfy in order to be eligible for selection. The **primary balancing criteria** (long-term effectiveness; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; cost) are the technical criteria upon which the detailed analysis is primarily based. The **modifying criteria** (state acceptance;

community acceptance) are assessed formally after the public comment period. The nine NCP evaluation criteria are defined in the following paragraphs as they pertain to this FS.

#### 4.1.1 Threshold Criteria

**Overall Protection of Human Health and the Environment** – This criterion assesses how well an alternative, as a whole, achieves and maintains protection of human health and the environment.

**Compliance with ARARs** – This criterion assesses how the alternatives comply with location-, chemical-, and action-specific ARARs, and whether a waiver is required or justified.

#### 4.1.2 Primary Balancing Criteria

**Long-Term Effectiveness and Permanence** – This criterion evaluates the effectiveness of the alternatives in protecting human health and the environment after response objectives have been met. It also considers the degree to which treatment is irreversible, and the type and quantity of residuals remaining after treatment.

**Reduction of Toxicity, Mobility, or Volume through Treatment** – This criterion examines the effectiveness of the alternatives in protecting human health and the environment during the construction and implementation of a remedy until response objectives have been met. It also considers the protection of the community, workers, and the environment during implementation of remedial actions.

**Short-Term Effectiveness** – This criterion examines the effectiveness of the alternatives in protecting human health and the environment during the construction and implementation of a remedy until response objectives have been met. It also considers the protection of the community, workers, and the environment during the implementation of remedial actions. The detailed analysis of each alternative includes an estimate of the time necessary for completion of the alternative (i.e., remedial duration). The time-frame estimates are based on published construction scheduling material and professional judgment.

**Implementability** – This criterion assesses the technical and administrative feasibility of an alternative and the availability of required goods and services. *Technical feasibility* considers the ability to construct and operate a technology and its reliability, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of a remedy. *Administrative feasibility* considers the ability to obtain approvals from other parties or agencies and the extent of required coordination with other parties or agencies.

**Cost** – This criterion evaluates the capital, and operation and maintenance costs of each alternative. Present-worth costs are presented to help compare costs among alternatives.

Costs are presented as a present worth and as a total cost for the lifetime of the remedial alternative based on the estimated clean-up time (EPA 1988). Tables presenting a summary of the costs for each alternative and identifying capital, O&M, total, and present-worth costs are included in each alternative's cost description.

Costs are intended to be within the target accuracy range of minus 30 percent to plus 50 percent of actual cost (EPA 1988). Assumptions used to develop and cost alternatives may or may not remain valid during alternative implementation. The selection of yards to be remediated in the cost estimates was based on extrapolation of lead and arsenic concentrations exceeding the RAL from the limited sampling of soil in yards presented in the RI. The available data were extrapolated within each area of OUI to each kind of yard and cost estimates were calculated based on this methodology.

Because many of the cost components of the total cost are based on volumes of soil excavated and volume of backfill, the average area of each yard and the depth of the excavation were estimated from data in the RI. The average area to be remediated at each residential yard was estimated by randomly selecting 10 residential properties; subtracting the area occupied by houses, garages, driveways, and sidewalks from the total area of the property; and dividing by two. A similar estimation technique was used for industrial and commercial properties. For parks, churches, and right-of-ways, the area of one quadrant of Riley Park was considered representative.

The depths of excavation used in the volume calculations were based on an extrapolation of the limited lead and arsenic concentrations in soil versus depth as presented in the RI.

Given the uncertainty associated with the limited data provided in the RI to identify which yard and the volumes of soil to be remediated, the recommendation in the RI is to sample and analyze each yard in OUI during the remedial design process to better establish a basis for remediation and a more accurate estimate of the final cost of the remediation.

Each cost estimate includes a present-worth analysis to evaluate expenditures that occur over different time periods. The analysis discounts future costs to a present worth and allows the cost of remedial alternatives to be compared on an equal basis. Present worth represents the amount of money that, if invested now and disbursed as needed, would be sufficient to cover costs associated with the remedial

action over its planned life. A discount rate of 5 percent was used to prepare the cost estimates (EPA 1988).

Each cost estimate includes the following items, as applicable:

- ☐ Engineering design, project and construction management (including health and safety, legal, and administrative fees), as a percentage of direct capital costs
- ☐ A contingency to account for unforeseen project complexities such as adverse weather, the need for additional and unexpected site characterization, and increased construction standby times as a percentage of direct capital costs
- ☐ Operation, maintenance, and monitoring costs

Details and assumptions pertaining to the cost estimate are presented in Appendix A and are discussed in each alternative's cost description.

#### **4.1.3 Modifying Criteria**

**State Acceptance** – This criterion considers the state's preferences among or concerns about the alternatives, including comments on ARARs or proposed use of waivers. This criterion is addressed following state inputs on the FS and Proposed Plan.

**Community Acceptance** – This criterion considers the community's preferences or concerns about the alternatives. This criterion is addressed following community input on the FS and Proposed Plan.

### **4.2 Individual Alternative Analysis**

As noted above in Section 2.3.2.2, the current and future land use for OU1 is the same and is primarily residential, with small sections of commercial/industrial and recreational land use within OU1. A summary of the remedial alternatives evaluation is shown in Table 4-1. The following alternatives are discussed based on future residential land-use scenarios.

#### **4.2.1 OU1 Alternative 1 – No Action**

##### **4.2.1.1 *Alternative 1 Description***

OU1 Alternative 1, the No Action alternative, was retained as a baseline against which to compare all other alternatives, as required by the NCP. This alternative does not include remedial action components to contain or reduce contaminant concentrations in the soil, nor does Alternative 1 control potential risks

from exposure to contaminated soil by implementing institutional controls or environmental monitoring. Site reviews will not be performed as part of this alternative.

#### 4.2.1.2 *Alternative 1 Assessment*

##### ☐ Overall Protection of Human Health and the Environment

Current and future land uses at OU1 present potential risks and hazards to human receptors. Direct contact with surface soil and subsurface soil is associated with cancer and non-cancer risks, due to lead and arsenic. No ecological risks are being considered for future land use scenarios. Alternative 1 does not include any actions to control potential risks or hazards posed to human receptors. As a result, Alternative 1 is not considered protective of human health and the environment.

##### ☐ Compliance with ARARs

Chemical-, location-, and action-specific ARARs triggered by Alternative 1 are presented in Table 4-2. The No Action alternative does not include any actions to reduce exposure to contamination in soil; therefore, all ARARs will not be attained.

##### ☐ Long-Term Effectiveness and Permanence

No controls for exposure and no long-term management measures will be undertaken. As a result, Alternative 1 will be ineffective.

##### ☐ Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 1 will not provide any reduction in toxicity, mobility, or volume of contaminated soil through removal or treatment.

##### ☐ Short-Term Effectiveness

Alternative 1 will not have any impacts on the community, workers, or the environment during implementation, since no remedial actions will be taken.

##### ☐ Implementability

Alternative 1 is considered to be easily implementable, since no remedial actions will be taken.

##### ☐ Cost

The construction, management, and O&M costs of Alternative 1 are presented in Table 4-3. The present-worth cost for Alternative 1 is estimated to be approximately \$43,000. No action will be performed under

this alternative. Cost basis information for OU1 is presented in Appendix A, Table A-2. A summary of costs for all the alternatives is shown in Table 4-7.

#### **4.2.2 OU1 Alternative 3 – On-Site Soil Cover + Institutional Controls**

##### **4.2.2.1 *Alternative 3 Description***

Alternative 3, the on-site soil cover and institutional controls alternative, includes remedial action components to contain contaminant concentrations in the soil. Under Alternative 3, yards that exceed the RALs (based on the results of the pre-remedial sampling) will be contained by a soil cover. This alternative controls potential risks and hazards from exposure to contaminated soil by limiting direct contact with impacted soil that exceeds the RALs by covering the soil under a soil cover. A visible barrier, such as orange construction fencing or landscaping fabric, is placed over the contaminated soil and beneath the soil cover. Residual contamination will be left in place and covered with a 12-inch-thick soil cover (composed of 6 inches of imported select borrow material, topped with 6 inches of topsoil) that will restrict direct contact with contaminated soil. The soil cover will be placed directly on top of the existing grade. By excavating 12 inches of soil around the perimeter of the yard, the soil cover will be tied into the existing grade along the street. The raised grade along the building foundation will require special consideration and design to accommodate basement windows, crawl spaces, entrance stairs, sidewalks, etc. After installation of the soil cover, each yard will be restored to its pre-remedial condition. Yards located within residential properties will be sodded, and non-residential properties will be seeded. As noted in Section 3.4, pre-remedial sampling is included in this alternative to further refine the extent of impacted soil in OU1 for the remedial design.

As part of the site O&M costs, the soil cover will be inspected and repaired as necessary on a semi-annual basis for the first 5 years, followed by an annual basis for years 5 through 30. Annual repairs will include re-grading portions of the soil cover, placing additional soil to maintain the 12-inch cover, and seeding or sodding the yards. Institutional controls will be implemented to maintain the integrity of the soil cover for the protection of site users from exposure to COCs in soil. Institutional controls may include property restrictions, such as: raised beds must be used for all gardening, all subsurface work (utility maintenance, foundation work, etc.) must be done in accordance with the Proposed Plan in order to protect workers and residents, and sufficient coverage of impacted soils must be maintained. In accordance with CERCLA requirements, 5-year reviews will be required with this alternative, because impacted soil will be left in place.

#### 4.2.2.2 *Alternative 3 Assessment*

##### ☐ Overall Protection of Human Health and the Environment

Current and future land uses at OU1 present potential risks and hazards to human receptors. Direct contact with surface soil and subsurface soil is associated with cancer and non-cancer risks, due to lead and arsenic. No ecological risks are being considered for future land use scenarios. Alternative 3 includes limiting the exposure of soil exceeding the RALs by placing a soil cover on the impacted yards. Alternative 3 includes remedial actions that will reduce future exposure to the soil and is considered protective of human-health and the environment. The exposure to contaminated soil will be reduced but not eliminated, since the contamination will remain onsite.

##### ☐ Compliance with ARARs

Chemical-, location-, and action-specific ARARs triggered by Alternative 3 are presented in Table 4-2. This alternative will reduce exposure to contamination in soil through remedial actions; therefore, all ARARs will be attained.

##### ☐ Long-Term Effectiveness and Permanence

Controls for exposure and long-term management measures will be implemented through the use of remedial action to cover the impacted soil with a soil cover and impose institutional controls to minimize disturbances of the soil cover. Inspections and repairs will be required to retain integrity of the soil cover and will be conducted at various intervals each year. The sloped areas of the soil cover along streets and foundations may undergo significant erosion and need frequent maintenance to retain a minimum 1 foot soil cover. However, the long-term effectiveness or permanent control of current and potential future risks will be based on inspections and repairs to verify and maintain the integrity of the soil cover. Long term effectiveness is contingent on maintenance of the soil cover. Inspections and maintenance of the soil cover will need to be conducted as long as the cover is in place.

##### ☐ Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 3 will not provide reductions in toxicity, mobility, or volume through treatment, since no treatment is being applied. The soil cover will require long-term O&M to verify that the integrity of the soil cover is still intact.

#### □ Short-Term Effectiveness

Measures will be in place to limit the risk of off-site migration during all remedial activities. Air monitoring will be conducted to verify proper protection of on-site personnel and residents during excavation activities, specifically during grading of each yard prior to cover installation. The work areas during soil excavation and loading will be wetted to minimize dust generation. Proper perimeter monitoring will be conducted to verify that remedial activities do not cause off-site migration. An increased level of truck traffic through the residential neighborhoods will occur during implementation. A health and safety plan (HASP), which will include a traffic control plan, will be created to minimize risks during construction.

#### □ Implementability

The installation of a soil cover is straightforward; however, it will be fairly difficult to implement. No new technologies need to be used or implemented. Materials for the soil cover can be easily obtained and installed; however, raising the grade of a yard by 1 foot will cause technical and administrative challenges. The areas where the soil cover must be tied into the existing grade (streets, etc.) will require excavation and will likely erode more rapidly than the surrounding areas and cause physical safety concerns for the elderly and young. Each yard will need to undergo a yard-specific remedial design to design proper stormwater drainage from the property. Community acceptance of this alternative may be difficult to obtain.

#### □ Cost

The present worth and capital costs of Alternative 3 are presented in Table 4-4. The present worth for Alternative 3 is estimated to be approximately \$20,900,000. The cost assumes that the long-term O&M will be conducted semi-annually to annually for 30 years. Detailed cost estimates are presented in Appendix A, Table A-3. A summary of costs for all the alternatives is included in Table 4-7.

### **4.2.3 OU1 Alternative 4A – Excavation of Soil Exceeding RALs + Off-Site Disposal + *Ex-Situ* Treatment Option**

#### **4.2.3.1 *Alternative 4A Description***

Alternative 4A, excavation of soil exceeding RALs and off-site disposal alternative (with an *ex situ* treatment option), includes remedial action components to remove impacted soil at OU1. The alternative reduces potential risks and hazards from exposure to contaminated soil by excavating impacted soil that exceeds RALs. This alternative incorporates excavations of soil exceeding RALs, the disposal of

excavated soil at an off-site Subtitle D landfill, and, as necessary, *ex-situ* treatment of soil using chemical stabilization to address soil exceeding the TC regulatory threshold (as characterized by the TCLP). Soil exceeding RALs will be excavated to a depth determined by pre-remedial sampling results. The maximum excavation depth will be 24 inches; however, the final excavation depth may vary, based on pre-remedial sample results. EPA's *Superfund Lead-Contaminated Residential Sites Handbook* (EPA 2003a) indicates that soil should be removed to a minimum depth of 12 inches bgs at residential properties and 24 inches bgs in gardens. Since future locations of gardens are unknown, a maximum excavation depth of 24 inches bgs is assumed for all areas. Since no local stockpile area has been identified, SulTRAC assumes that soil will be directly loaded into roll-off containers and transported to the landfill. If a stockpiling location that is acceptable to the community is identified, then stockpiling will be reconsidered. If necessary, any contaminated soil below 24 inches bgs will have a visual barrier, such as orange construction fence or landscape fabric, placed above the contaminated soil and beneath the clean backfill soil. The cost estimate assumes that approximately half of the yards (approximately 2.5% of all yards being remediated) that are being excavated to 24 inches bgs will exceed the RALs, based on the anticipated pre-remedial sample results. A visual barrier will be set at 24 inches bgs in each of these yards, and institutional controls will be implemented to protect the barrier.

Based on the pre-remedial sampling results, yards with sample results that exceed the TC threshold concentration of 2,400 mg/kg total lead, based on RI results, will be excavated and impacted soil will be loaded and disposed of separately at a Subtitle C landfill. The cost estimate assumes that 7% of the excavated soil may exceed the TC regulatory threshold and be classified as a hazardous waste. As required to meet LDRs and to decrease disposal costs and future liability, soil exceeding the TC threshold will be treated *ex situ* using chemical stabilization. The chemical stabilization substance(s) will bind with the COCs to reduce the COC concentrations to below the TC regulatory threshold, such that treated soil can be disposed of in a Subtitle D landfill. It is assumed that the *ex-situ* treatment will be applied offsite at a treatment facility. Though unlikely, if the *ex-situ* soil treatment is unable to reduce the necessary lead concentrations to below the TC regulatory threshold, the treated soil that exceeds the TC regulatory threshold will be disposed of in a Subtitle C landfill.

Excavated soil will be replaced with clean soil, including 6 inches of topsoil, to maintain the original grade. Each yard will be restored to its pre-remedial condition. Yards located within residential properties will be sodded and non-residential properties will be seeded. Once the properties are sodded or seeded, O&M of the sod/seed, including watering, fertilizing, and cutting, will be conducted for 30 days. After the initial 30-day period, property owners will be responsible for the maintenance of their own

yards. Any soil that exceeds RALs that is left in place below 24 inches bgs will require 5-year reviews, in accordance with CERCLA requirements.

#### 4.2.3.2 *Alternative 4A Assessment*

##### ☐ Overall Protection of Human Health and the Environment

Current and future land uses at OU1 present potential risks and hazards to human receptors. Direct contact with surface soil and subsurface soil is associated with cancer and non-cancer risks, due to lead and arsenic. No ecological risks are considered for future land-use scenarios. Alternative 4A includes removal of soils above RALs and disposal offsite. Alternative 4A includes remedial actions that will reduce and eliminate future exposure to the soil and is considered protective of human health and the environment. The exposure to COCs will be eliminated, since the identified contamination will be taken offsite.

##### ☐ Compliance with ARARs

Chemical-, location-, and action-specific ARARs triggered by Alternative 4A are presented in Table 4-2. Soil excavation, *ex-situ* treatment, and off-site disposal will remove exposure to identified soil contamination that exceeds RALs; therefore, ARARs will be attained.

##### ☐ Long-Term Effectiveness and Permanence

By removing the contaminated soil above the RALs and disposing of it offsite, the risk onsite will be permanently reduced. With impacted soil being removed from the site and properly disposed at an off-site location, this alternative will be reliable and effective. If all soil above RALs is excavated, then no long-term monitoring or evaluations will be needed. If contaminated soil below 24 inches bgs is left in place, then inspections and 5-year reviews will be required. The long-term effectiveness or permanent control of current and potential future risks will be based on the inspections (as part of the 5-year review) to verify the integrity of the top 24 inches of clean soil and that the visual barrier remains in place.

##### ☐ Reduction of Toxicity, Mobility, and Volume through Treatment

As required, Alternative 4A will eliminate the mobility and toxicity of metals in soil that exceed the TC threshold in approximately 7% of the soil through *ex-situ* treatment. The volume of soil that exceeds RALs will be reduced by removing the contaminated soil and disposing of the soil in an approved landfill.

#### ☐ Short-Term Effectiveness

Measures will be conducted to limit the risk of off-site migration during all remedial activities. Soil excavation and loading will occur onsite while air monitoring will be conducted to verify proper protection of on-site personnel and residents during remedial activities. The work areas during soil excavation and loading will be wetted to minimize dust generation. Proper perimeter monitoring will be conducted to verify that remedial activities do not cause off-site migration. A large increase in vehicle traffic, specifically heavy truck traffic, will occur during remedial activities to transport all of the contaminated soils to an off-site facility. In addition, workers will have contact with impacted soil during excavation. A HASP will be created to minimize risk of exposure to contaminants. The HASP will include a traffic control plan to minimize risks associated with heavy machinery and increased truck traffic during construction.

#### ☐ Implementability

The implementability of the excavation and disposal offsite is fairly straightforward and commonplace for remedial activities. No new technologies will need to be used or implemented. Equipment and materials for soil excavation, treatment, and disposal can be easily obtained. A staging area for equipment and clean soil to be used as backfill will need to be established within OUI. This alternative will require waste manifests and documentation of impacted soil for transportation and disposal purposes, both of which are readily available.

#### ☐ Cost

The present worth and capital costs of Alternative 4A are presented in Table 4-5. The present worth of Alternative 4A is estimated to be approximately \$29,800,000. The cost assumes that the institutional controls and 5-year reviews will be required for a fraction of the yards remediated for 30 years. Detailed cost estimates are presented in Appendix A, Table A-4. A summary of costs for all the alternatives is included in Table 4-7.

### **4.2.4 OUI Alternative 4B – Excavation to Native Sand + Off-Site Disposal + *Ex-Situ* Treatment Option**

#### **4.2.4.1 *Alternative 4B Description***

Alternative 4B, excavation to native sand and off-site disposal at yards that exceed RALs, with *ex-situ* treatment as necessary, includes remedial action components to remove impacted soil at OUI. This alternative reduces potential risks and hazards from exposure to contaminated soil by excavating all

identified non-native sand soil, primarily composed of fill material, at yards that exceed RALs. This alternative incorporates excavations of soil exceeding RALs, with a goal of the total removal of identified impacted soils, the disposal of excavated soil at an off-site Subtitle D landfill, and, as necessary, *ex-situ* treatment of soil using chemical stabilization to address lead concentrations exceeding the TC regulatory threshold. Soil in yards that exceed the RALs will be excavated from surface grade down to the native sand soil horizon, which is estimated to be no more than 24 inches bgs, based on results of the RI. EPA's *Superfund Lead-Contaminated Residential Sites Handbook* (EPA 2003a) specifies that soil should be removed to a minimum depth of 12 inches bgs at residential properties and 24 inches bgs in gardens. Since the future locations of gardens are unknown, a maximum excavation depth of 24 inches bgs is assumed for all areas. Removing the non-native, fill soil material will result in the removal of identified impacted soil. During the RI, native sand was encountered at every sample location between 0 and 24 inches bgs. RI results indicated that the native sand beneath the fill soils at the site is both clean and very easily distinguished visually. For the purposes of this FS, it is assumed that native sand will be encountered no deeper than 24 inches bgs. The cost estimate assumes that all soil above the native sand will be excavated and disposed of offsite. Since no local stockpile area has been identified, SulTRAC assumes that soil will be directly loaded into roll-off containers and transported to the landfill. If a stockpiling location that is acceptable to the community is identified, then stockpiling will be reconsidered.

Based on the pre-remedial sampling results, yards with sample results that exceed the TC threshold concentration of 2,400 mg/kg total lead, based on RI results, will be loaded and disposed of separately. The cost estimate assumes that 7% of the excavated soil may exceed the TC regulatory threshold. As required by LDRs for non-hazardous waste disposal, soil exceeding the TC threshold will be treated *ex situ* using chemical stabilization. The chemical stabilization substance(s) will bind with the COCs to reduce the COC concentrations to below the TC regulatory threshold, such that treated soil can be disposed of in a Subtitle D landfill. It is assumed that the *ex-situ* treatment will be applied offsite at a treatment facility. Though unlikely, if the *ex-situ* soil treatment does not decrease the necessary lead concentrations to below the TC regulatory threshold, the treated soil that exceeds the TC regulatory threshold will be disposed of in a Subtitle C landfill. Excavated soil will be replaced with clean soil, including 6 inches of topsoil, to maintain the original grade.

Each yard will be restored to its pre-remedial condition. Yards located within residential properties will be sodded and non-residential properties will be seeded. Once the properties are sodded or seeded, O&M of the sod/seed, including watering, fertilizing, cutting, will be conducted for 30-days. After the initial

30-day period, property owners will be responsible for the maintenance of their own yards. This alternative will result in total removal of identified impacted soils; therefore, 5-year reviews will not be required, as no non-native, fill soil material will be left behind.

#### 4.2.4.2 *Alternative 4B Assessment*

##### ☐ Overall Protection of Human Health and the Environment

Current and future land uses at OU1 present potential risks and hazards to human receptors. Direct contact with surface soil and subsurface soil is associated with cancer and non-cancer risks, due to lead and arsenic. No ecological risks are being considered for future land-use scenarios. Alternative 4B includes removal of soil in areas that exceed an RAL and disposal offsite. Alternative 4B also includes remedial actions that will eliminate future exposure to the soil and is considered protective of human health and the environment. The exposure will be eliminated, since the identified contamination will be removed from the site.

##### ☐ Compliance with ARARs

Chemical-, location-, and action-specific ARARs triggered by Alternative 4B are presented in Table 4-2. Soil excavation, *ex-situ* treatment, and off-site disposal will eliminate exposure to identified contamination in soil through remedial actions; therefore, all ARARs will be attained.

##### ☐ Long-Term Effectiveness and Permanence

By removing the contaminated soil above the RALs and disposing of the material offsite, the on-site risk will be eliminated. With all contamination being removed from the site and properly disposed at an off-site location, this alternative will be reliable and effective. If all soil above RALs is excavated, then no long-term monitoring or evaluations will be needed.

##### ☐ Reduction of Toxicity, Mobility, and Volume through Treatment

As required, Alternative 4B will eliminate the mobility and toxicity of metals in soil that exceed the TC threshold in approximately 7% of the soil through *ex-situ* treatment. The volume of soil with concentrations of COCs that exceed RALs will be reduced by removing the identified contaminated soil and disposing of the soil in an approved off-site landfill.

##### ☐ Short-Term Effectiveness

Measures will be implemented to limit the risk of off-site migration during all remedial activities. Soil excavation and loading will occur onsite, while air monitoring will be conducted to verify proper

protection of on-site personnel and residents during all remedial activities. During soil excavation and loading, the work areas will be wetted to minimize dust generation. Proper perimeter monitoring will be conducted to verify that remedial activities do not cause off-site migration. A large increase in vehicle traffic, specifically heavy truck traffic, will occur during remedial activities to transport all of the contaminated soils to an off-site facility. In addition, workers will have contact with impacted soil during excavation.

A HASP will be created to minimize risk of exposure to contaminants. The HASP will include a traffic control plan to minimize risks associated with heavy machinery and increased truck traffic during construction.

☐ Implementability

The implementability of the excavation and disposal offsite is fairly straightforward and commonplace for remedial activities. No new technologies will need to be used or implemented. Equipment and materials for soil excavation, treatment, and disposal can be easily obtained. A staging area for equipment and clean soil to be used as backfill will need to be established within OU1. The alternative will require waste manifests and documentation of impacted soil for transportation and disposal purposes, both of which are readily available.

☐ Cost

The present worth and capital costs of Alternative 4B are presented in Table 4-6. The present worth for Alternative 4B is estimated to be approximately \$45,300,000. Detailed cost estimates are presented in Appendix A, Table A-5. A summary of costs for all the alternatives is included in Table 4-7.

## TABLES

- 4-1 Remedial Alternative Evaluation Summary
- 4-2 Compliance with ARARs
- 4-3 Feasibility Study Cost Estimate, Alternative 1, No Action
- 4-4 Feasibility Study Cost Estimate, Alternative 3, On-Site Soil Cover
- 4-5 Feasibility Study Cost Estimate, Alternative 4A, Excavation of Soil Exceeding RALs + Off-Site Disposal + *Ex-Situ* Treatment Option
- 4-6 Feasibility Study Cost Estimate, Alternative 4B, Excavation to Native Sand + Off-Site Disposal + *Ex-Situ* Treatment Option
- 4-7 Feasibility Study Cost Estimate Comparison

Table 4-1  
Remedial Alternative Evaluation Summary  
USS Lead Site, OU-1  
East Chicago, Indiana

Evaluation Criteria	Alternative 1 No Action	Alternative 3 On-Site Soil Cover + Institutional Controls	Alternative 4A Excavation of Soil Exceeding RALs + Off-Site Disposal + <i>Ex Situ</i> Treatment Option	Alternative 4B Excavation to Native Sand + Off-Site Disposal + <i>Ex Situ</i> Treatment Option
<b>Overall Protection to Human Health and the Environment</b> Protection of human health and the environment	Not protective	Somewhat protective	Protective	Protective
<b>Compliance with ARARs</b> Location-specific ARARs Action-specific ARARs Chemical-specific ARARs	Not in compliance Not in compliance Not in compliance	In compliance In compliance In compliance	In compliance In compliance In compliance	In compliance In compliance In compliance
<b>Long-Term Effectiveness and Permanence</b> Magnitude of residual risk Adequacy and reliability of controls Need for 5-year review	Residual risk remains No controls Required	Some residual risk Somewhat reliable Required	Minimal residual risk Reliable to very reliable May be required	No residual risk Very reliable Not required
<b>Reduction of Toxicity, Mobility, or Volume through Treatment</b> Treatment processes used and materials treated Amount of hazardous material destroyed or treated Expected reduction in toxicity, mobility, or volume of the waste Irreversibility of treatment Type and quantity of residuals that will remain following treatment Statutory preference for treatment	None None None Not applicable Not applicable Does not satisfy	None None None Not applicable Not applicable Does not satisfy	Some treatment utilized ~7% treatment Toxicity and mobility reduced Not likely reversible Metals less than TC threshold Partially satisfies	Some treatment utilized ~7% treatment Toxicity and mobility reduced Not likely reversible Metals less than TC threshold Partially satisfies
<b>Short-Term Effectiveness</b> Protection of workers during remedial action Protection of the community during remedial action Potential environmental impacts of remedial action Time until protection is achieved	Not applicable Not applicable Not applicable Protection not achieved	High High Low Immediate	Moderate-High Moderate-High Low Immediate	Moderate-High Moderate-High Low Immediate
<b>Implementability</b> Technical feasibility Reliability of technology Administrative feasibility Availability of services, equipment, and materials	Not applicable Not applicable Not applicable Not applicable	Moderate Somewhat reliable Difficult Readily available	Easy Very reliable Feasible Readily available	Easy Very reliable Feasible Readily available
<b>Cost</b> Total construction cost Total engineering and construction management cost Total present worth O&M Period of analysis (yrs) Total cost (including 20% contingency)	\$0 \$0 \$36,000 NA \$43,000	\$13,900,000 \$2,800,000 \$740,000 30 \$20,900,000	\$21,500,000 \$3,200,000 \$67,000 30 \$29,800,000	\$32,800,000 \$4,960,000 \$0 NA \$45,400,000

**TABLE 4-2**  
**Compliance with ARARs**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable, Relevant, and Appropriate Requirements	Description	Soil Alternatives			
		Alt. 1	Alt. 3	Alt. 4A	Alt. 4B
CLEAN AIR ACT (CAA) of 1974					
40 CFR 7401	The Act is intended to protect the quality of air and promote public health. Title I of the Act directed the EPA to publish national ambient air quality standards for “criteria pollutants.” In addition, EPA has provided national emission standards for hazardous air pollutants under Title III of the Act. Hazardous air pollutants are also designated hazardous substances under CERCLA. The Clean Air Act amendments of 1990 greatly expanded the role of National Emission Standards for Hazardous Air Pollutants by designating 179 new hazardous air pollutants and directed EPA to attain maximum achievable control technology standards for emission sources. Such emission standards are potential ARARs if selected remedial technologies produce air emissions of regulated hazardous air pollutants.	X	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FLOODPLAIN MANAGEMENT EXECUTIVE ORDER 11988					
40 CFR Part 6, Appendix A	Requires federal agencies to evaluate the potential adverse effects associated with direct and indirect development of a floodplain. Alternatives that involve modification/construction within a floodplain may not be selected unless a determination is made that no practicable alternative exists. If no practicable alternative exists, potential harm must be minimized and action taken to restore and preserve the natural and beneficial values of the floodplain.	NA	NA	NA	NA
CLEAN WATER ACT (CWA) OF 1977					
Protection of Wetlands Executive Order 11990 [40 CFR Part 6, Appendix A]	Under this Order, federal agencies are required to minimize the destruction, loss, or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. If remediation is required within wetland areas and no practical alternative exists, potential harm must be minimized and action taken to restore natural and beneficial values	NA	NA	NA	NA

**TABLE 4-2**  
**Compliance with ARARs**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable, Relevant, and Appropriate Requirements	Description	Soil Alternatives			
		Alt. 1	Alt. 3	Alt. 4A	Alt. 4B
Federal Water Pollution Control Act Section 401: Water Quality Certification	Establishes a permit program to regulate a discharge into the navigable waters of the U.S., including wetlands.	NA	NA	NA	NA
National Pollutant Discharge Elimination System (NPDES) 33 U.S.C. §1251-1387; Clean Water Act NPDES Permit Program (40 CFR 122)	Regulates discharges of pollutants to navigable waters.	NA	NA	NA	NA
<b>FISH AND WILDLIFE COORDINATION ACT</b>					
Fish and Wildlife Coordination Act; 16 U.S.C. §§ 661 et seq. 16 USC 742a 16 USC 2901 40 CFR 6.302 50 CFR 402	Actions that affect species/habitat require consultation with U.S. Department of Interior, U.S. Fish and Wildlife Service, and National Marine Fisheries Service, and/or state agencies, as appropriate, to ensure that proposed actions do not jeopardize the continued existence of the species or adversely modify or destroy critical habitat. The effects of water-related projects on fish and wildlife resources must be considered. Action must be taken to prevent, mitigate, or compensate for project-related damages or losses to fish and wildlife resources. Consultation with the responsible agency is also strongly recommended for on-site actions. Under 40 CFR Part 300.38, these requirements apply to all response activities under the National Contingency Plan.	NA	NA	NA	NA
<b>RESOURCE CONSERVATION AND RECOVERY ACT OF 1976</b>					
Off-Site Land Disposal Subtitle C [40 CFR 260-268]	Soil and/or sediment that is excavated for off-site disposal and constitutes a hazardous waste must be managed in accordance with the requirements of RCRA.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**TABLE 4-2**  
**Compliance with ARARs**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable, Relevant, and Appropriate Requirements	Description	Soil Alternatives			
		Alt. 1	Alt. 3	Alt. 4A	Alt. 4B
Land Disposal Restrictions [40 CFR 268]	The land disposal restrictions (LDR) provide a second measure of protection from threats posed by hazardous waste disposal by ensuring that hazardous waste cannot be placed on the land until the waste meets specific treatment standards to reduce the mobility or toxicity of its hazardous constituents. Hazardous waste destined for land disposal must meet the applicable Land Disposal Regulations of 40 CFR 268.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Off-Site Land Disposal Subtitle D [40 CFR 258]	Criteria for Municipal Solid Waste Landfills, establishes requirements for the operation of landfills accepting non-hazardous solid waste. These requirements are applicable to facilities used for the disposal of non-hazardous soil and/or sediment.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Criteria for Municipal Solid Waste Landfills for Site Capping [40 CFR 258, Subpart F]	Provides minimum standards for cover systems at solid-waste disposal facilities.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Definition of a hazardous waste [40 CFR 261.3(d) and 329 IAC 3.1]	For all hazardous waste related equipment, remove or decontaminate all hazardous waste residues, contaminated containment components, contaminated soils, and structures and equipment contaminated with waste, and manage them as hazardous unless 40 CFR 261.3(d) applies.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hazardous waste determination [40 CFR 262.11 and 329 IAC 3.1-6]	Requires that a proper hazardous waste determination must be made on all wastes generated from remedial actions.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pre-Transportation Requirements [40 CFR 262.30, 262.31, 262.32, and 262.33 and 329 IAC 3.1-7 and 329 IAC 3.1-8]	All hazardous waste must be properly packaged, with labels, markings, and placards, prior to transport.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**TABLE 4-2**  
**Compliance with ARARs**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable, Relevant, and Appropriate Requirements	Description	Soil Alternatives			
		Alt. 1	Alt. 3	Alt. 4A	Alt. 4B
Standards applicable to the generators of hazardous waste - The manifest [40 CFR 262, Subpart B and 329 IAC 3.1-7 and 329 IAC 3.1-8]	Hazardous waste stored onsite in containers for greater than 90 days shall be managed in accordance with 40 CFR 262, Subpart B (329 IAC 3.1-7 and 329 IAC 3.1-8).	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Standards applicable to the generators of hazardous waste - The manifest [40 CFR 262, Subpart B and 329 IAC 3.1-7 and 329 IAC 3.1-8]	Hazardous waste must be manifested as such for transport to a permitted treatment, storage, or disposal facility (TSDF)	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities - Waste piles [40 CFR 264, Subpart L]	Any excavated contaminated soils must not be placed back on the ground so as to create a waste pile. Covered rollofs may be used.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use and management of containers [40 CFR 265, Subpart I and 329 IAC 3.1-10]	Hazardous waste stored onsite in containers for 90 days or less shall be managed in accordance with the standards of 40 CFR 265, Subpart I (329 IAC 3.1-10).	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>ENDANGERED SPECIES ACT</b>					
Endangered Species Act [16 USC 1531; 50 CFR 200]	Requires that federal agencies ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or adversely modify critical habitat.	NA	NA	NA	NA

**TABLE 4-2**  
**Compliance with ARARs**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable, Relevant, and Appropriate Requirements	Description	Soil Alternatives			
		Alt. 1	Alt. 3	Alt. 4A	Alt. 4B
NATURAL HISTORIC PRESERVATION ACT					
National Historic Preservation Act [16 USC 661 et seq.]; 36 CFR Part 65	Establishes procedures to provide for preservation of scientific, historical, and archaeological data that might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program. If scientific, historical, or archaeological artifacts are discovered at the site, work in the area of the site affected by such discovery will be halted pending a completion of any data recovery and preservation activities required pursuant to the act and any implementing regulations.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DEPARTMENT OF TRANSPORTATION					
Requirements for the Transport of Hazardous Materials [40 CFR 172]	Transportation of hazardous materials on public roadways must comply with the requirements.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
OTHER FEDERAL GUIDELINES TO BE CONSIDERED					
Integrated Risk Information System (IRIS)	Risk reference doses (RfD) are estimates of daily exposure levels that are unlikely to cause significant adverse non-carcinogenic health effects over a lifetime. Cancer Slope Factors (CSF) are used to compute the incremental cancer risk from exposure to site contaminants and represent the most up-to-date information on cancer risk from EPA's Carcinogen Assessment Group.	X	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
EPA Regional Screening Levels	EPA Regional Screening Levels (RSLs and associated guidance necessary to calculate them) are risk-based tools for evaluating and cleaning up contaminated sites. The RSLs represent Agency guidelines and are not legally enforceable standards.	X	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Occupational Safety and Health Act [29 CFR 61]	The Act was passed in 1970 to ensure worker safety on the job. The U.S. Department of Labor oversees it. Worker safety at hazardous waste sites is addressed under 29 CFR 1910. 120: Hazardous Waste Operations and Emergency Response. General worker safety is covered elsewhere within the law.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**TABLE 4-2**  
**Compliance with ARARs**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable, Relevant, and Appropriate Requirements	Description	Soil Alternatives			
		Alt. 1	Alt. 3	Alt. 4A	Alt. 4B
INDIANA ADMINISTRATIVE CODE					
Indiana Solid Waste Rules (IAC Title 329)	This law applies to remedies that involve off-site disposal of materials typically involved with excavations. Contaminated soils or wastes that are excavated for off-site disposal would be tested for hazardous waste characteristics and, if soil or waste is found to be hazardous waste, the requirements of the Rules would be followed.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Generator Responsibilities for Waste Information (329 IAC 10-7.2-1)	Requires all wastes undergo a waste determination, and if found to be nonhazardous, be disposed of in a permitted solid waste disposal facility.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Indiana Air Pollution Control Regulations (IAC Title 326)	This law applies to the regulation air emissions, for activities such as excavation that have the potential to create dust.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rule 4. Fugitive Dust Emission (326 IAC 6-4-1[4])	Rule 4 establishes that visible fugitive dust must not escape beyond the property line or boundaries of the property, right-of-way, or easement on which the source is located.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Motor vehicle fugitive dust sources (326 IAC 6-4-4)	No vehicle driven on any public right of way may allow its contents to escape and form fugitive dust.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ground Water Quality Standards (327 IAC 2-11-2(e))	States that no person shall cause the groundwater in a drinking water supply well to have contaminant concentration that results in an exceedance of numeric criteria contained within the rule for drinking water class groundwater, creates a condition that is injurious to human health, creates an exceedance of specific indicator criteria levels contained within the rule, or renders the well unusable for normal domestic use.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**TABLE 4-2**  
**Compliance with ARARs**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Potential Applicable, Relevant, and Appropriate Requirements	Description	Soil Alternatives			
		Alt. 1	Alt. 3	Alt. 4A	Alt. 4B
Voluntary Remediation of Hazardous Substances and Petroleum (Indiana Code [IC] 13-25-5)	IC 13-25-5 established the Voluntary Remediation Program in 1993 and gave the IDEM the authority to establish guidelines for voluntary site closure. Under this authority IDEM developed a non-rule policy document, the Risk Integrated System of Closure (RISC), to guide site closures within the authority of IDEM's remediation programs. This guidance document does not have the effect of law.	X	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contained-in Policy Guidance for RCRA	Guidance document on management of remediation waste. This guidance document does not have the effect of law.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>CITY OF EAST CHICAGO</b>					
Ordinance for the Control of Stormwater	Regulates the capture and conveyance of stormwater runoff in order to mitigate the damaging effects of stormwater runoff; correct stormwater collection and conveyance problems; protect public health, welfare, safety, and the environment, and fund the activities of stormwater management including design, planning, regulation, education, coordination, construction, operation, maintenance, inspection and enforcement activities. Based on CWA NPDES regulations.	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Notes:

NA Not Applicable  
☐ Alternative complies with ARAR  
X Alternative does not comply with ARAR

**TABLE 4-3**  
**FEASIBILITY STUDY COST ESTIMATE**  
**ALTERNATIVE 1: NO ACTION**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Estimate Category	Cost			
	Eastern Area	Southwestern Area	Northwestern Area	TOTAL
<b>PRE-REMEDIAL DESIGN SAMPLING</b>				
Sample Labor	\$0	\$0	\$0	\$0
ODCs	\$0	\$0	\$0	\$0
<b>REMEDY CONSTRUCTION</b>				
Preconstruction Activities	\$0	\$0	\$0	\$0
Site Preparation and Access	\$0	\$0	\$0	\$0
Institutional Controls	\$0	\$0	\$0	\$0
Contaminated Soil Excavation and Backfilling/Soil Cover	\$0	\$0	\$0	\$0
Contaminated Soil Transportation and Disposal	\$0	\$0	\$0	\$0
Property Restoration	\$0	\$0	\$0	\$0
Contractor's Oversight, Health & Safety, Quality Control	\$0	\$0	\$0	\$0
<b>Construction Subtotal</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
<b>ENGINEERING &amp; CONSTRUCTION MANAGEMENT</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
<b>OPERATIONS AND MAINTENANCE</b>	<b>\$14,544</b>	<b>\$10,188</b>	<b>\$11,268</b>	<b>\$36,000</b>
<b>Project Subtotal</b>	<b>\$14,544</b>	<b>\$10,188</b>	<b>\$11,268</b>	<b>\$36,000</b>
20% Contingency	\$3,000	\$2,000	\$2,000	\$7,000
<b>Project Total</b>	<b>\$18,000</b>	<b>\$12,000</b>	<b>\$13,000</b>	<b>\$43,000</b>

**TABLE 4-4**  
**FEASIBILITY STUDY COST ESTIMATE**  
**ALTERNATIVE 3: ON-SITE SOIL COVER**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Estimate Category	Cost			
	Eastern Area	Southwestern Area	Northwestern Area	TOTAL
<b>PRE-REMEDIAL DESIGN SAMPLING</b>				
Sample Labor	\$583,000	\$408,000	\$451,000	\$1,442,000
ODCs	\$84,000	\$60,000	\$66,000	\$210,000
<b>REMEDY CONSTRUCTION</b>				
Preconstruction Activities	\$180,000	\$186,000	\$173,000	\$539,000
Site Preparation and Access	\$411,000	\$612,000	\$239,000	\$1,262,000
Institutional Controls	\$415,000	\$485,000	\$331,000	\$1,231,000
Contaminated Soil Excavation and Backfilling	\$0	\$0	\$0	\$0
Contaminated Soil Transportation and Disposal	\$348,000	\$469,000	\$0	\$817,000
Soil Cover	\$1,213,000	\$1,960,000	\$797,000	\$3,970,000
Property Restoration	\$1,330,000	\$1,797,000	\$668,000	\$3,795,000
Contractor's Oversight, Health & Safety, Quality Control	\$210,000	\$315,000	\$105,000	\$630,000
<b>Construction Subtotal</b>	<b>\$4,800,000</b>	<b>\$6,300,000</b>	<b>\$2,800,000</b>	<b>\$13,900,000</b>
<b>ENGINEERING &amp; CONSTRUCTION MANAGEMENT</b>	<b>\$956,000</b>	<b>\$1,304,000</b>	<b>\$545,000</b>	<b>\$2,805,000</b>
<b>OPERATIONS AND MAINTENANCE</b>	<b>\$296,940</b>	<b>\$208,005</b>	<b>\$230,055</b>	<b>\$735,000</b>
<b>Project Subtotal</b>	<b>\$6,100,000</b>	<b>\$7,800,000</b>	<b>\$3,600,000</b>	<b>\$17,400,000</b>
20% Contingency	\$1,220,000	\$1,560,000	\$720,000	\$3,500,000
<b>Project Total</b>	<b>\$7,300,000</b>	<b>\$9,400,000</b>	<b>\$4,300,000</b>	<b>\$20,900,000</b>

**TABLE 4-5**  
**FEASIBILITY STUDY COST ESTIMATE**  
**ALTERNATIVE 4A: EXCAVATION OF SOIL EXCEEDING RALS + OFF-SITE**  
**DISPOSAL + EX SITU TREATMENT OPTION**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Estimate Category	Cost			
	Eastern Area	Southwestern Area	Northwestern Area	TOTAL
<b>PRE-REMEDIAL DESIGN SAMPLING</b>				
Sample Labor	\$583,000	\$408,000	\$451,000	\$1,442,000
ODCs	\$84,000	\$60,000	\$66,000	\$210,000
<b>REMEDY CONSTRUCTION</b>				
Preconstruction Activities	\$180,000	\$186,000	\$173,000	\$539,000
Site Preparation and Access	\$460,000	\$685,000	\$268,000	\$1,413,000
Institutional Controls	\$5,000	\$5,000	\$5,000	\$15,000
Contaminated Soil Excavation and Backfilling	\$2,203,000	\$3,793,000	\$1,548,000	\$7,544,000
Contaminated Soil Transportation and Disposal	\$1,509,000	\$2,411,000	\$943,000	\$4,863,000
Soil Cover	\$1,000	\$2,000	\$1,000	\$4,000
Property Restoration	\$1,407,000	\$2,278,000	\$927,000	\$4,612,000
Contractor's Oversight, Health & Safety, Quality Control	\$280,000	\$455,000	\$175,000	\$910,000
<b>Construction Subtotal</b>	<b>\$6,700,000</b>	<b>\$10,300,000</b>	<b>\$4,600,000</b>	<b>\$21,600,000</b>
<b>ENGINEERING &amp; CONSTRUCTION MANAGEMENT</b>	<b>\$991,000</b>	<b>\$1,548,000</b>	<b>\$656,000</b>	<b>\$3,195,000</b>
<b>OPERATIONS AND MAINTENANCE</b>	<b>\$27,068</b>	<b>\$18,961</b>	<b>\$20,971</b>	<b>\$67,000</b>
<b>Project Subtotal</b>	<b>\$7,700,000</b>	<b>\$11,900,000</b>	<b>\$5,300,000</b>	<b>\$24,900,000</b>
20% Contingency	\$1,540,000	\$2,380,000	\$1,060,000	\$4,980,000
<b>Project Total</b>	<b>\$9,200,000</b>	<b>\$14,300,000</b>	<b>\$6,400,000</b>	<b>\$29,900,000</b>

**TABLE 4-6**  
**FEASIBILITY STUDY COST ESTIMATE**  
**ALTERNATIVE 4B: EXCAVATION TO NATIVE SAND + OFF-SITE**  
**DISPOSAL + EX SITU TREATMENT OPTION**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Estimate Category	Cost			
	Eastern Area	Southwestern Area	Northwestern Area	TOTAL
<b>PRE-REMEDIAL DESIGN SAMPLING</b>				
Sample Labor	\$583,000	\$408,000	\$451,000	\$1,442,000
ODCs	\$84,000	\$60,000	\$66,000	\$210,000
<b>REMEDY CONSTRUCTION</b>				
Preconstruction Activities	\$180,000	\$186,000	\$173,000	\$539,000
Site Preparation and Access	\$460,000	\$685,000	\$268,000	\$1,413,000
Institutional Controls	\$0	\$0	\$0	\$0
Contaminated Soil Excavation and Backfilling	\$4,282,000	\$6,961,000	\$2,838,000	\$14,081,000
Contaminated Soil Transportation and Disposal	\$2,920,000	\$4,387,000	\$1,716,000	\$9,023,000
Soil Cover	\$0	\$0	\$0	\$0
Property Restoration	\$1,407,000	\$2,278,000	\$927,000	\$4,612,000
Contractor's Oversight, Health & Safety, Quality Control	\$490,000	\$700,000	\$280,000	\$1,470,000
<b>Construction Subtotal</b>	<b>\$10,400,000</b>	<b>\$15,700,000</b>	<b>\$6,700,000</b>	<b>\$32,800,000</b>
<b>ENGINEERING &amp; CONSTRUCTION MANAGEMENT</b>	<b>\$1,601,000</b>	<b>\$2,367,000</b>	<b>\$992,000</b>	<b>\$4,960,000</b>
<b>OPERATIONS AND MAINTENANCE</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
<b>Project Subtotal</b>	<b>\$12,000,000</b>	<b>\$18,100,000</b>	<b>\$7,700,000</b>	<b>\$37,800,000</b>
20% Contingency	\$2,400,000	\$3,620,000	\$1,540,000	\$7,560,000
<b>Project Total</b>	<b>\$14,400,000</b>	<b>\$21,700,000</b>	<b>\$9,200,000</b>	<b>\$45,400,000</b>

**TABLE 4-7**  
**FEASIBILITY STUDY COST ESTIMATE COMPARISON**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Estimate Category	OU-1 Soil Alternatives - Total Costs			
	Alt 1: No Action	Alt 3: On-site Soil Cover	Alt 4A: Excavation of soil exceeding RALs + Off-site Disposal + Ex Situ Treatment Option	Alt 4B: Excavation to native sand + Off-site Disposal + Ex Situ Treatment Option
Construction	\$0	\$13,900,000	\$21,600,000	\$32,800,000
Engineering and Construction Mgmt.	\$0	\$2,805,000	\$3,195,000	\$4,960,000
Operations and Maintenance	\$36,000	\$735,000	\$67,000	\$0
<b>Subtotal</b>	<b>\$36,000</b>	<b>\$17,400,000</b>	<b>\$24,900,000</b>	<b>\$37,800,000</b>
Contingency (20%)	\$7,000	\$3,500,000	\$4,980,000	\$7,560,000
<b>Total</b>	<b>\$43,000</b>	<b>\$20,900,000</b>	<b>\$29,900,000</b>	<b>\$45,400,000</b>

## **5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES**

This section of the FS presents a comparative analysis of the remedial alternatives for OU1. The remedial alternatives are detailed above in Section 4.2, and include three active alternatives: Alternative 3 (1-foot soil cover), Alternative 4A (removal of contaminated soils), and Alternative 4B (removal of all non-native soils at yards exceeding RALs). In accordance with FS guidance, Alternative 1 (no action) is also evaluated in this section. As described in FS guidance (EPA 1988), “The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so that the key tradeoffs the decision maker must balance can be identified.” The NCP is the basis for the comparative analysis and identifies nine criteria for comparative analysis. This section of the FS evaluates the first seven criteria identified in the NCP. The remaining two criteria (state and community acceptance) will be evaluated in the ROD once formal comments on the FS and proposed plan have been received.

Comparative analysis of remedial alternatives and total costs associated with each alternative is described below and summarized in Table 5-1. A more detailed cost analysis of each alternative is presented in Tables 4-3 through 4-6. The RAO (reducing human health risks through exposure to contaminated soils through ingestion, direct contact, or inhalation to acceptable levels) would be achieved and ARARs would be met for each of the active alternatives (Alternatives 3, 4A, and 4B).

### **5.1 Overall Protection of Human Health and the Environment**

This criterion assesses how well the alternatives achieve and maintain protection of human health and the environment.

Alternative 1 (no action) would provide no improvement over current conditions, no risk reduction, and would not be protective of human health or the environment. Because Alternative 1 does not meet this threshold criterion, it is not discussed further in this section of the FS.

Alternatives 3, 4A, and 4B are each expected to be effective remedies for OU1 that are expected to be protective of human health and the environment. Protection of human health and the environment would be achieved by addressing potential pathways of exposure to contaminated soils. As discussed in Section 1.3.5, the exposure pathways at OU1 are ingestion, direct contact, and inhalation.

Ingestion of contaminated soils in yards is the primary expected exposure route at the USS Lead site. Residents could be exposed to contaminants adhering to soils through ingestion of homegrown produce or

through direct ingestion of contaminated soil. Alternatives 3, 4A, and 4B are all considered effective at preventing ingestion. Alternative 3 relies on a soil cover and compliance with institutional controls (2-foot deep raised beds for produce) for its protectiveness while Alternatives 4A and 4B would achieve protectiveness through removal of contaminated soils.

Direct contact can result from recreational activities, gardening, landscaping, or excavation. Each of the active alternatives would prevent most direct contact by covering or removing the contaminated soils. However, direct contact may result from unauthorized excavation activities for Alternative 3 because the contaminated soils would remain in place under a soil cover.

Exposure through inhalation would most likely occur through windborne transport of contaminated dust and soil due to the COIs' strong tendency to adsorb to soil particles and low volatility (SulTRAC 2012). Each of the active alternatives would prevent exposure to contaminated dust by removing or covering the contaminated soils. However, the remedial activities may generate dust and cause short-term exposure as discussed in Section 5.5.

Alternatives 3, 4A, and 4B address potential exposure to contaminants by covering or removing the contaminated soil. Alternative 4B would eliminate potential exposure because all of the contaminated soil would be removed down to native sand. Alternatives 3 and 4A would reduce or eliminate inhalation exposure. Alternative 3 would leave contaminated soil behind at all properties under a soil cover. Alternative 4A would leave contaminated soils in place at the few properties where soils below 2 feet may be contaminated. At those properties where contaminated soil remains at depth, EPA would rely on institutional controls (such as prohibiting excavation of contaminated soils) to prevent exposure.

The overall protectiveness to human health and the environment would be similar for each active remedial alternative, provided that the cover is properly maintained and institutional controls are effective. Active Alternatives 3 and 4A may allow exposure to contaminated soils through unauthorized excavation. The potential for such exposure is highest for Alternative 3 where the most contaminated soils remain in place.

## **5.2 Compliance with Applicable or Relevant and Appropriate Requirements**

This criterion assesses how the alternatives comply with regulatory requirements. Federal and state regulatory requirements that are either applicable or relevant and appropriate are known as ARARs. Only state requirements that are more stringent than federal requirements are ARARs.

The potential ARARs include chemical-specific ARARs, action-specific ARARs, and location-specific ARARs, as shown in Table 4-2. Alternatives 3, 4A and 4B would all achieve the identified ARARs. Alternative 1 would not achieve the identified ARARs.

### 5.3 Long-term Effectiveness and Permanence

This criterion evaluates the effectiveness of the alternatives in protecting human health and the environment when the cleanup is complete. It also considers the effectiveness of the cleanup over the long term.

Each of the active alternatives would meet the RAO and provide long-term effectiveness and permanence once the RAO is met. The active alternatives are combinations of proven and reliable remedial process, and the potential for failure of any individual component is low.

- Alternative 3 would achieve long-term effectiveness through covering the metals-contaminated soil onsite as the primary component of the remedy, with O&M and institutional controls to ensure and verify the ongoing effectiveness of the remedy. Implementation of Alternative 3 would introduce topographic changes to the properties that must be maintained to ensure protectiveness. Therefore, O&M is critical to the protectiveness of this alternative to prevent erosion and potential exposure to contaminated soils that remain in place.
- Alternative 4A would achieve long-term effectiveness by removing soil that exceeds RALs from OU1 and disposing of it at an off-site disposal facility. Alternative 4A has potential for some contaminated material to be left in place below 24 inches bgs if the contamination above RALs extends deeper than 24 inches. (Native sand was encountered above 24 inches bgs at all but a few locations in OU1 where borings were advanced). Any material that exceeds RALs and is left in place would require O&M and institutional controls to maintain the remedy.
- Alternative 4B would achieve long-term effectiveness by removing all non-native soils down to 2 feet bgs from yards that exceeded RALs in OU1 and disposing of it at an off-site disposal facility.

Alternatives 3, 4A, and 4B are proven technologies that meet the requirements for effectiveness and permanence. Compared to Alternative 3, Alternatives 4A and 4B provide an additional level of protectiveness because wastes above RALs will be removed and disposed of off-site. Alternative 4B provides the greatest degree of long-term protectiveness because all soil exceeding RALs would be removed from impacted yards.

#### **5.4 Reduction of Toxicity, Mobility, or Volume through Treatment**

This criterion addresses the preference for selecting remedial actions that use treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances. This preference is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible encapsulation, or reduction of total volume of contaminated media.

EPA has estimated that approximately 7% of the soils at OU1 have lead concentration levels that would be considered hazardous waste. These soils are considered principal threat wastes due to their toxicity and potential to leach to groundwater.

Alternatives 1 and 3 do not reduce the toxicity, mobility, or volume of contaminated materials since no treatment is applied. Alternatives 4A and 4B would reduce the toxicity and mobility of those above-mentioned soils with lead levels that exceed the toxicity characteristic threshold through ex-situ treatment prior to disposal, but would not reduce the volume of contaminated materials. The amount of material requiring treatment is expected to be the same for Alternatives 4A and 4B. None of the alternatives would result in a reduction of volume by treatment.

#### **5.5 Short-term Effectiveness**

This criterion examines the effectiveness of the alternatives in protecting human health and the environment during the cleanup until the cleanup is complete. It also considers protection of the community, workers, and the environment during the cleanup. For OU1, the short-term effectiveness criterion is primarily related to the volume of contaminated soils addressed in each alternative, the time necessary to implement the remedy, potential risks to workers, and potential impacts to the community during construction. Short-term effectiveness of the remedial alternatives is summarized in Table 5-2.

Each of the active alternatives would have short-term impacts including increased potential for exposure to lead-contaminated soils and construction related risks. Potential for exposure to lead-contaminated soils would increase in the short-term through creation of dust during excavation activities and increased potential for workers to come in contact with lead-contaminated soils above RALs. Construction related risks include potential for vehicle accidents, traffic and noise from construction vehicles, increased wear on local roads, and other risks associated with construction work. These impacts can be mitigated by implementing a project-specific health and safety plan, keeping excavation areas properly wetted,

planning truck routes to minimize disturbances to the surrounding community, and other best management practices.

There are no short-term impacts associated with implementation of Alternative 1. Alternative 3 requires the least disturbance and shortest construction time. Compared to Alternative 3, Alternatives 4A and 4B present greater short-term impacts because of the amount of materials moved to and from the site, as well as the increased duration of construction. The duration of the alternatives progresses from an estimated 18 months for Alternative 3 to 26 months for Alternative 4A, to 42 months for Alternative 4B. Increasing duration of construction increases truck traffic, potential for vehicle accidents, construction-related and exposure risks to workers, as well as additional qualitative impacts to the local community, such as noise and dust.

## **5.6 Implementability**

This criterion assesses the technical and administrative feasibility of an alternative and the availability of required goods and services. *Technical feasibility* considers the ability to construct and operate a technology and its reliability, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of a remedy. *Administrative feasibility* considers the ability to obtain approvals from other parties or agencies and the extent of required coordination with other parties or agencies.

Alternatives 3, 4A, and 4B are proven, readily implementable, and have been used successfully for other environmental cleanup projects. In addition, Alternatives 3, 4A, and 4B could all be completed using readily available conventional earth-moving equipment, and most of the necessary services and construction materials are expected to be readily available. Qualified commercial contractors with experience are available locally to perform the work.

Alternative 3 is more difficult to implement than 4A and 4B, since it requires a more detailed remedial design plan to maintain safe grading for each of the contaminated yards. Raising the grade of each impacted yard by 1 foot would cause technical and administrative challenges. The areas where the soil cover must be tied into the existing grade (streets, etc.) would require excavation and would likely erode more rapidly than the surrounding areas, thereby causing physical safety concerns for the elderly and young. Each yard would need to undergo a custom remedial design to achieve proper stormwater drainage from the property. In addition, community acceptance of Alternative 3 may be difficult to obtain.

All of the alternatives are administratively feasible. Although no permits would be required, a similar level of coordination would be needed with state and local parties during design and construction activities for each of the active alternatives.

## 5.7 Cost

This criterion evaluates the capital and operation and maintenance costs of each alternative. Present-worth costs are presented to help compare costs among alternatives with different implementation times.

The present worth costs for the alternatives presented in this FS are presented in Table 5-1. The detailed estimates and associated assumptions are presented in Tables 4-3 through 4-6 and in Appendix A. The cost estimates are consistent with the level of estimation required in the FS phase, with an accuracy of +50 to -30 percent. A final cost estimate would be developed and refined during the remedial design process after the selection of a recommended remedy.

Alternative 1 has no associated capital or O&M costs since no action would be taken, but would require periodic costs associated with 5-year reviews as shown in Table 5-1. The remaining three alternatives are progressively more expensive. Alternative 3 is the least costly active alternative (\$20.9 million) and Alternative 4A is the next most costly option (\$29.9 million). Alternative 4B is the most costly alternative (\$45.4 million), costing more than twice as much as Alternative 3.

## 5.8 Summary

The purpose of the comparative analysis is to identify the relative advantages and/or disadvantages of each remedial action alternative. Table 5-1 summarizes the advantages and disadvantages described above. Alternative 1, No Action, failed to meet the threshold criteria and, therefore, this alternative was not further considered for the primary balancing criteria or sustainability. The remaining alternatives passed the threshold criteria and are compared based on primary balancing criteria in Table 5-1. Two of the alternatives, Alternative 4A and Alternative 4B have equal scores (total score of 18 out of 25); Alternative 4A has a lower estimated cost than Alternative 4B, but Alternative 4B has better long-term implementability. In order of highest- to lowest-ranked alternative, the alternatives rank as follows:

- ☐ Alternative 4A – Excavation of Soil Exceeding RALs + Off-Site Disposal + *Ex-Situ* Treatment Option
- ☐ Alternative 4B – Excavation to Native Sand + Off-Site Disposal + *Ex-Situ* Treatment Option
- ☐ Alternative 3 – On-Site Soil Cover + Institutional Controls

Alternative 4A was ranked above Alternative 4B due to the overall lower cost.

## **TABLES**

- 5-1 Comparative Evaluation of Remedial Alternatives
- 5-2 Summary of Short-Term Effectiveness Considerations

TABLE 5-1  
COMPARATIVE EVALUATION OF REMEDIAL ALTERNATIVES  
USS Lead Site, OU-1  
East Chicago, Indiana

Evaluation Criteria	Remedial Alternatives			
	Alternative 1 No Action	Alternative 3 On-Site Soil Cover + Institutional Controls	Alternative 4A Excavation of Soil Exceeding RALs + Off-Site Disposal + <i>Ex Situ</i> Treatment Option	Alternative 4B Excavation to Native Sand + Off-Site Disposal + <i>Ex Situ</i> Treatment Option
THRESHOLD CRITERIA <sup>1</sup>				
Overall protectiveness of human health and the environment	Not protective. No action would be taken	Protective. Contamination would be covered and contained	Protective. Contaminated would be excavated and disposed of off-site	Protective. Contaminated would be excavated and disposed of off-site
Criteria Score	Fail	Pass	Pass	Pass
Compliance with ARARs	Would not meet ARARs	Meets ARARs	Meets ARARs	Meets ARARs
Criteria Score	Fail	Pass	Pass	Pass
PRIMARY BALANCING CRITERIA <sup>2</sup>				
Long-term effectiveness and permanence	Ineffective and temporary Site conditions would remain the same	Somewhat effective Soil cover requires O&M, institutional controls, and is a permanent remedy	Highly effective Excavation of soil is effective as contamination is removed, some contamination may remain at depth and will require O&M and institutional controls	Highly effective and permanent Excavation of soil is highly effective and excavation of all non-native soil removes all impacted soil
Criteria Score	1	2	4	5
Reduction of toxicity, mobility, or volume through treatment	Does not reduce toxicity, mobility, or volume No treatment applied	Somewhat effective at reducing toxicity, mobility, and/or volume No treatment applied; some soil excavated and removed from site	Highly effective at reducing toxicity, mobility, and/or volume Treatment applied to soil that is excavated and exceeds TC threshold, which will decrease toxicity and mobility of treated soil	Highly effective at reducing toxicity, mobility, and/or volume Treatment applied to soil that is excavated and exceeds TC threshold, which will decrease toxicity and mobility of treated soil
Criteria Score	1	2	4	4
Short-term effectiveness	No impacts during implementation No worker risks as no action would be taken	Slight impact during implementation Implementation over 18 month period; worker risk associated with minimal dermal contact, inhalation, and ingestion. Risks are controllable. Community impacts associated with dust, noise, traffic.	Minimal impacts during implementation Implementation over 26 month period; worker risk associated with moderate dermal contact, inhalation, and ingestion. Risks are controllable. Community impacts associated with dust, noise, traffic.	Minimal impacts during implementation Implementation over 40 month period; worker risk associated with moderate dermal contact, inhalation, and ingestion. Risks are controllable. Community impacts associated with dust, noise, traffic.
Criteria Score	5	4	3	3
Implementability	Easily implementable Implementable as no action would be taken	Difficult to implement Proven technology, soil cover installation on residential properties will be difficult to create safe and effective grading and to maintain	Easily implementable Proven technology that has been implemented at similar sites.	Easily implementable Proven technology that has been implemented at similar sites.
Criteria Score	5	2	5	5

TABLE 5-1  
COMPARATIVE EVALUATION OF REMEDIAL ALTERNATIVES  
USS Lead Site, OU-1  
East Chicago, Indiana

Evaluation Criteria	Remedial Alternatives			
	Alternative 1 No Action	Alternative 3 On-Site Soil Cover + Institutional Controls	Alternative 4A Excavation of Soil Exceeding RALs + Off-Site Disposal + <i>Ex Situ</i> Treatment Option	Alternative 4B Excavation to Native Sand + Off-Site Disposal + <i>Ex Situ</i> Treatment Option
Cost (relative to other alternatives) <sup>3</sup>	\$43,000	\$20,900,000	\$29,900,000	\$45,400,000
Criteria Score	5	3	2	1
MODIFYING CRITERIA <sup>4</sup>				
CERCLA Criteria - Alternative Total Score	NA <sup>1</sup>	13	18	18
CERCLA Criteria - Alternative Rank	4	3	1	2

- Notes:
- 1 The Threshold Criteria have been evaluated on a pass/fail basis. An alternative must pass both threshold criteria in order to be considered as a remedial action. Alternatives that fail either threshold criterion are marked as "not applicable" (NA) for the alternative total score.
- 2 The Primary Balancing Criteria have been evaluated on a scale of 1-5. Details on each of the scales for each criterion are listed below:
- Long-term effectiveness and permanence:

1 = Ineffective and temporary

2 = Somewhat effective

3 = Effective

4 = Highly effective

5 = Highly effective and permanent

Reduction of toxicity, mobility, or volume through treatment:

1 = Does not reduce toxicity, mobility, or volume

2 = Somewhat effective at reducing toxicity, mobility, and/or volume

3 = Effective at reducing toxicity, mobility, and/or volume

4 = Highly effective at reducing toxicity, mobility, and/or volume

5 = Complete reduction of toxicity, mobility, and/or volume

Short-term effectiveness (impact to community, site workers, and environment):

1 = Detrimental impacts during implementation

2 = Significant impacts during implementation

3 = Minimal impacts during implementation

4 = Slight impact during implementation

5 = No impacts during implementation

Implementability:

1 = Very difficult to implement

2 = Difficult to implement

3 = Implementable

4 = Readily implementable

5 = Easily implementable

Cost (relative to other alternatives):

Ranked by total net present value cost
- 3 A full presentation of alternative costs can be found in Sections 4, 5, and Appendix A of the FS report.
- 4 The two Modifying Criteria, State acceptance and community acceptance, will be evaluated following comment on the FS report and the proposed plan, and will be addressed in the ROD.

**TABLE 5-2**  
**SUMMARY OF SHORT-TERM EFFECTIVENESS CONSIDERATIONS**  
**USS Lead Site, OU-1**  
**East Chicago, Indiana**

Evaluation Criteria	Remedial Alternatives			
	Alternative 1 No Action	Alternative 3 On-Site Soil Cover + Institutional Controls	Alternative 4A Excavation of Soil Exceeding RALs + Off-Site Disposal + <i>Ex Situ</i> Treatment Option	Alternative 4B Excavation to Native Sand + Off-Site Disposal + <i>Ex Situ</i> Treatment Option
<b>Total Area Addressed</b>	No areas addressed	179,000 yd <sup>2</sup>	179,000 yd <sup>2</sup>	179,000 yd <sup>2</sup>
<b>Total Volume of COC- Containing Soil Excavated</b>	No volume of material addressed	12,000 cy	54,000 cy	106,000 cy
<b>Duration to Implement Construction Phase</b>	No time period to implement	18 months	26 months	40 months
<b>Worker Risks</b>	No worker risks since no action is taken.	Minimal exposure to contaminated soil since excavation will only occur around perimeter of yard	Greater than Alternative 3; exposure to contaminated soil during excavation	Slightly greater than Alternative 4A; exposure to contaminated soil during excavation
<b>Community Impacts</b>	Continued risks from contaminated soil to community.	Increased trucking of clean backfill, noise, and dust creation	Greater than Alternative 3; increased trucking for soil disposal and clean backfill delivery, noise, and dust creation	Greater than Alternative 4A; due to additional soil volume, increased trucking for soil disposal and clean backfill delivery, noise, and dust creation

## 6.0 REFERENCES

- 35 IAC Part 742. Title 35 Illinois Administrative Code Part 742. "Tiered Approach to Corrective Action Objectives."
- CH2M HILL. 2006. "Final Remedial Investigation Report, Jacobsville Neighborhood Soil Contamination Site, Evansville, Indiana." September.
- Federal Remediation Technologies Roundtable (FRTR). 2007. "Screening Matrix and Reference Guide, Version 4." Accessed at on May 24, 2012, On-Line Address: <http://www.frtr.gov/scrntools.htm>
- Geochemical Solutions. 2001. "Site-Wide Sampling and Analysis Report." July 24.
- Geochemical Solutions. 2004. "Draft Final USS Lead Modified RCRA Facility Investigation (MRFI) Report." March 1.
- Indiana Department of Environmental Management (IDEM). 2009. "Risk Integrated System of Closure (RISC) Technical Resource Guidance Document." Final dated February 15, 2001. Revised September 9.
- Massachusetts Department of Environmental Protection (MassDEP). 2002. "Technical Update: Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil." May. Table 1. MassDEP Identified Background Levels in Soil.
- Mauro, D., P. DeClercq, R. Siegener, and A. Coleman (Mauro, et al). 2006. "Survey of the distribution and sources of PAHs in urban surface soils." Land Contamination & Reclamation, Vol. 14, No. 2, pp. 513-524.
- Resource Consultants, Inc. (RCI). 1990. Site Assessment Plan, U.S.S. Lead Refinery, Inc., East Chicago, Indiana, RCI Project No. 1-3214.00. August 3.
- SulTRAC. 2011. "Technical Memorandum No. 2, Remedial Alternatives Screening, Draft, U.S. Smelter and Lead Refinery (USS Lead) Superfund Site, Lake County, Indiana." September.
- SulTRAC. 2012. "Final Remedial Investigation Report, Draft, U.S. Smelter and Lead Refinery (USS Lead) Superfund Site, Lake County, Indiana." May.
- U.S. Environmental Protection Agency (EPA). 1988. "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA." Interim Final. Office of Emergency and Remedial Response. Washington, DC. EPA/540/G-89/004. October.
- EPA. 1989. *Risk Assessment Guidance for Superfund (RAGS). Volume I. Human Health Evaluation Manual (Part A)*. Interim Final. Office of Emergency and Remedial Response. EPA/540/1-89/002. December.
- EPA. 1991. "RAGS Supplemental Guidance, Standard Default Exposure Factors." Interim Final. Office of Solid Waste and Emergency Response (OSWER) Directive 9285.6-03. March 25.
- EPA. 1994. "National Oil and Hazardous Substances Pollution Contingency Plan, Revised." 40 CFR Parts 9 and 300. September 1994.

- EPA. 2003a. "Superfund Lead-Contaminated Residential Sites Handbook." Office of Emergency and Remedial Response, OSWER Publication No. 9285.7-50. August.
- EPA. 2003b. "Recommendations of the Technical Review Workgroup for Lead for an Interim Approach for Assessing Risks Associated with Adult Exposures to Lead in Soil." Technical Review Workgroup for Lead. January. Final (December 1996). EPA-540-R-03-001. January. On-Line Address: <http://www.epa.gov/superfund/lead/products/adultpb.pdf>
- EPA. 2008. Hazardous Ranking System Documentation Record. US Smelter and Lead Refinery. April.
- EPA. 2009a. "RAC II Region 5 Statement of Work For Remedial Investigation/Feasibility Study (RI/FS), USS Lead Superfund Site, Lake County, Indiana. June 19.
- EPA. 2009b. ALM Spreadsheet (MS Excel). June 21. On-Line Address: [http://www.epa.gov/superfund/lead/products/ALM\\_2009.xls](http://www.epa.gov/superfund/lead/products/ALM_2009.xls)
- EPA. 2009c. Integrated Exposure Uptake Biokinetic Model for Lead in Children. Windows Version. (IEUBKwin. Version 1.1 Build 9). June. On-Line Address: <http://www.epa.gov/superfund/lead/products.htm>
- EPA. 2010. "Regional Screening Level (RSL) Summary Table, November 2010." Accessed online at: [http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/Generic\\_Tables/pdf/master\\_sl\\_table\\_run\\_NOVEMBER2010.pdf](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/pdf/master_sl_table_run_NOVEMBER2010.pdf)
- EPA. 2011a. "Community Involvement Plan, USS Lead Superfund Site, East Chicago, Indiana." U.S. Environmental Protection Agency, Region 5. April.
- EPA. 2011b. "Pollution/Situation Report, USS LEAD -2, Removal Polrep, Initial Removal Polrep" U.S. Environmental Protection Agency, Region 5. November 1.
- EPA. 2011c. "Pollution/Situation Report, USS LEAD -2, Removal Polrep" U.S. Environmental Protection Agency, Region 5. November 16.
- EPA. 2011d. "Pollution/Situation Report, USS LEAD -2, Removal Polrep" U.S. Environmental Protection Agency, Region 5. December 15.
- U.S. Geological Survey (USGS). 2003. "Concentrations of Polynuclear Aromatic Hydrocarbons and Inorganic Constituents in Ambient Surface Soils, Chicago, Illinois: 2001-02." Water Resources Investigation Report 03-4105.
- Weston Solutions, Inc. (Weston). 2009. "Federal On-Scene Coordinator's Report, Rev. 1 Comprehensive Environmental Response, Compensation, and Liability Act, Removal Action at the USS Lead Site, East Chicago, Lake County, Indiana, Site ID 053J." August 31.

## **APPENDIX A**

### **BASIS FOR COST ESTIMATES**

---

Table A-1, Soil Area and Volume Estimates

Table A-2, Detailed Cost Estimate, Alternative 1: No Action

Table A-3, Detailed Cost Estimate, Alternative 3: On-Site Soil Cover

Table A-4, Detailed Cost Estimate, Alternative 4A: Excavation of Soil Exceeding RALs +  
Off-Site Disposal + Ex Situ Treatment Option

Table A-5, Detailed Cost Estimate, Alternative 4B: Excavation to Native Sand + Off-Site Disposal + Ex  
Situ Treatment Option

Table A-6, Operation and Maintenance Cost Estimate

Table A-7, Sampling Costs



**APPENDIX A**  
**BASIS FOR COST ESTIMATES**  
**TABLE A-2**  
**DETAILED COST ESTIMATE, ALTERNATIVE 1: NO ACTION**  
**USS LEAD SITE OU-1, EAST CHICAGO, INDIANA**

Cost Estimating Activity	Unit Cost	Units	No. of Units	Cost	No. of Units	Cost	No. of Units	Cost	Notes
			EASTERN AREA		SOUTHWESTERN AREA		NORTHWESTERN AREA		
REMEDY CONSTRUCTION									
Pre-remedial sampling									
Pre-remedial soil sampling labor	\$84.35 hrs		0	\$0	0	\$0	0	\$0	
Coordination with Residents	\$165.09 Yards		0	\$0	0	\$0	0	\$0	
TCLP analysis (non CLP)	\$110.00 sample		0	\$0	0	\$0	0	\$0	
Car/Gas	\$600.00 wk		0	\$0	0	\$0	0	\$0	
Per diem (hotel/food)	\$156.00 day		0	\$0	0	\$0	0	\$0	
Materials/team	\$120.00 wk		0	\$0	0	\$0	0	\$0	
Trailer	\$120.00 wk		0	\$0	0	\$0	0	\$0	
CLP Shipping	\$240.00 wk		0	\$0	0	\$0	0	\$0	
			Subtotal	\$0	Subtotal	\$0	Subtotal	\$0	
Remedial Design									
Remedial design plans	\$500,000.00 LS		0	\$0	0	\$0	0	\$0	
			Subtotal	\$0	Subtotal	\$0	Subtotal	\$0	
Preconstruction Activities									
Mobilization & Demobilization	\$100,000.00 LS		0	\$0	0	\$0	0	\$0	
Coordination with Residents	\$82.55 Yards		0	\$0	0	\$0	0	\$0	
Contractor Prepared Preconstruction Plans									
HASP	\$5,000.00 LS		0	\$0	0	\$0	0	\$0	
SWPPP Plan	\$15,000.00 LS		0	\$0	0	\$0	0	\$0	
Traffic Plan	\$10,000.00 LS		0	\$0	0	\$0	0	\$0	
Work Plan	\$8,000.00 LS		0	\$0	0	\$0	0	\$0	
Sampling Plan	\$6,000.00 LS		0	\$0	0	\$0	0	\$0	
			Subtotal	\$0	Subtotal	\$0	Subtotal	\$0	
Site Preparation & Access									
Erosion Controls and Air Monitoring	\$1.20 Sq Yd		0	\$0	0	\$0	0	\$0	
Utility locate	\$0.80 Sq Yd		0	\$0	0	\$0	0	\$0	
Pre-remedial site survey	\$3.90 Sq Yd		0	\$0	0	\$0	0	\$0	
Site clearing	\$1.60 Sq Yd		0	\$0	0	\$0	0	\$0	
			Subtotal	\$0	Subtotal	\$0	Subtotal	\$0	
Institutional Controls									
Deed Restrictions	\$943.40 Yards		0	\$0	0	\$0	0	\$0	
Institutional Control Monitoring Plan (ICMP)	\$5,000.00 LS		0	\$0	0	\$0	0	\$0	
			Subtotal	\$0	Subtotal	\$0	Subtotal	\$0	
Contaminated Soil Excavation and Backfilling									
Contaminated soil excavation - residential	\$75.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Contaminated soil excavation - non-residential	\$50.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Clean fill, placed and compacted - residential	\$55.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Clean fill, placed and compacted - non-residential	\$40.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Topsoil, placed and compacted - residential	\$75.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Topsoil, placed and compacted - non-residential	\$50.00 Cu Yd		0	\$0	0	\$0	0	\$0	
			Subtotal	\$0	Subtotal	\$0	Subtotal	\$0	

APPENDIX A  
BASIS FOR COST ESTIMATES  
TABLE A-2  
DETAILED COST ESTIMATE, ALTERNATIVE 1: NO ACTION  
USS LEAD SITE OU-1, EAST CHICAGO, INDIANA

Cost Estimating Activity		Unit Cost	Units	No. of Units	Cost	No. of Units	Cost	No. of Units	Cost	Notes
				EASTERN AREA		SOUTHWESTERN AREA		NORTHWESTERN AREA		
Contaminated Soil Transportation and Disposal										
Offsite Hauling and Disposal (non-hazardous)		\$72.00	Cu Yd	0	\$0	0	\$0	0	\$0	
Offsite Treatment, Hauling, and Disposal (hazardous)		\$183.00	Cu Yd	0	\$0	0	\$0	0	\$0	
Acceptance Sampling & Analysis		\$4.86	Cu Yd	0	\$0	0	\$0	0	\$0	
				Subtotal	\$0	Subtotal	\$0	Subtotal	\$0	
Soil Cover										
Soil Cover, Clean Fill, Placed and Compacted - residential		\$55.00	Cu Yd	0	\$0	0	\$0	0	\$0	
Soil Cover, Clean Fill, Placed and Compacted - non-residential		\$40.00	Cu Yd	0	\$0	0	\$0	0	\$0	
Soil Cover, Topsoil, Placed and Compacted - residential		\$75.00	Cu Yd	0	\$0	0	\$0	0	\$0	
Soil Cover, Topsoil, Placed and Compacted - non-residential		\$50.00	Cu Yd	0	\$0	0	\$0	0	\$0	
Barrier Fabric		\$0.90	Sq Yd	0	\$0	0	\$0	0	\$0	
				Subtotal	\$0	Subtotal	\$0	Subtotal	\$0	
Property Restoration										
Sod and landscape		\$15.70	Sq Yd	0	\$0	0	\$0	0	\$0	
Seed and landscape		\$7.80	Sq Yd	0	\$0	0	\$0	0	\$0	
Property restoration		\$7.80	Sq Yd	0	\$0	0	\$0	0	\$0	
Final Survey		\$2.74	Sq Yd	0	\$0	0	\$0	0	\$0	
				Subtotal	\$0	Subtotal	\$0	Subtotal	\$0	
Contractor's Oversight, Health & Safety, Quality Control										
Contractor Health and Safety		\$5,000.00	Month	0	\$0	0	\$0	0	\$0	
Contractor Management and Oversight		\$20,000.00	Month	0	\$0	0	\$0	0	\$0	
Contractor Sub Contracted Quality Control		\$10,000.00	Month	0	\$0	0	\$0	0	\$0	
				Subtotal	\$0	Subtotal	\$0	Subtotal	\$0	
CONSTRUCTION SUBTOTAL					\$0		\$0		\$0	
ENGINEERING AND CONSTRUCTION MANAGEMENT										
Onsite Construction Quality Assurance		\$40,000.00	Month	0	\$0	0	\$0	0	\$0	
Design, Engin., Procurement, Constr. Management & Reporting:		10.00% of Construction Cost			\$0		\$0		\$0	
ENGINEERING & CM SUBTOTAL					\$0		\$0		\$0	
CONSTRUCTION & ENGINEERING TOTAL					\$0		\$0		\$0	
OPERATIONS AND MAINTENANCE										
Annual O&M			Years	30	\$0	0	\$0	0	\$0	
5 Year Remedy Reviews			Reviews	6	\$14,544	6	\$10,188	6	\$11,268	
Net Present Value of O&M and Remedy Reviews (Interest Rate = 5%)					\$14,544		\$10,188		\$11,268	
TOTAL CONSTRUCTION, ENGINEERING, AND O&M COST					\$14,544		\$10,188		\$11,268	

**APPENDIX A**  
**BASIS FOR COST ESTIMATES**  
**TABLE A-3**  
**DETAILED COST ESTIMATE, ALTERNATIVE 3: ON-SITE SOIL COVER**  
**USS LEAD SITE OU-1, EAST CHICAGO, INDIANA**

Cost Estimating Activity	Unit Cost	Units	No. of Units <sup>1</sup>	Cost	No. of Units <sup>1</sup>	Cost	No. of Units <sup>1</sup>	Cost	Notes
			EASTERN AREA		SOUTHWESTERN AREA		NORTHWESTERN AREA		
REMEDY CONSTRUCTION									
Pre-remedial sampling									Includes pre-field, field, post-field labor, and reporting for remaining 1183 properties in OU-1. Assumes 10 hrs per property.  Secure access agreements for pre-remedial sampling and remediation. Assume all 1271 OU-1 properties require access agreements, assume 4 hours per property. Since not all properties have both front and back yards to be remediated, unit cost has been adjusted accordingly. Assume one sample from 7% of yards submitted for TCLP analysis. Assume 4 FTE, 2 field teams, 10 hr/day, 4 hr/property sampled, for pre-remedial sampling labor Assume 4 FTE, 2 field teams, 10 hr/day, 4 hr/property sampled, for pre-remedial sampling labor
Pre-remedial soil sampling labor	\$84.35 lrs		4,779	\$403,000	3,348	\$282,000	3,703	\$312,000	
Coordination with Residents	\$165.09 Yards		1089	\$180,000	763	\$126,000	843	\$139,000	
TCLP analysis (non CLP)	\$110.00 sample		35	\$4,000	25	\$3,000	27	\$3,000	
Car/Gas	\$600.00 wk		19	\$11,000	13	\$8,000	15	\$9,000	
Per diem (hotel/food)	\$156.00 day		382	\$60,000	268	\$42,000	296	\$46,000	
Materials/team	\$120.00 wk		19	\$2,000	13	\$2,000	15	\$2,000	
Trailer	\$120.00 wk		19	\$2,000	13	\$2,000	15	\$2,000	
CLP Shipping	\$240.00 wk		19	\$5,000	13	\$3,000	15	\$4,000	
			Subtotal	\$667,000	Subtotal	\$468,000	Subtotal	\$517,000	
Preconstruction Activities									
Mobilization & Demobilization	\$100,000.00 LS		1	\$100,000	1	\$100,000	1	\$100,000	Confirm access to properties for remediation. Assume 623 properties require access agreements for remediation, assume 2 hours per property
Coordination with Residents	\$82.55 Yards		435	\$36,000	509	\$42,000	346	\$29,000	
Contractor Prepared Preconstruction Plans									
HASP	\$5,000.00 LS		1	\$5,000	1	\$5,000	1	\$5,000	
SWPPP Plan	\$15,000.00 LS		1	\$15,000	1	\$15,000	1	\$15,000	
Traffic Plan	\$10,000.00 LS		1	\$10,000	1	\$10,000	1	\$10,000	
Work Plan	\$8,000.00 LS		1	\$8,000	1	\$8,000	1	\$8,000	
Sampling Plan	\$6,000.00 LS		1	\$6,000	1	\$6,000	1	\$6,000	
			Subtotal	\$180,000	Subtotal	\$186,000	Subtotal	\$173,000	
Site Preparation & Access									
Erosion Controls and Air monitoring	\$1.20 Sq Yd		61,382	\$74,000	91,408	\$110,000	35,748	\$43,000	
Utility locate	\$0.80 Sq Yd		-	\$0	-	\$0	-	\$0	
Pre-remedial site survey	\$3.90 Sq Yd		61,382	\$239,000	91,408	\$356,000	35,748	\$139,000	
Site clearing	\$1.60 Sq Yd		61,382	\$98,000	91,408	\$146,000	35,748	\$57,000	
			Subtotal	\$411,000	Subtotal	\$612,000	Subtotal	\$239,000	
Institutional Controls									
Deed Restrictions	\$943.40 Yards		435	\$410,000	509	\$480,000	346	\$326,000	All properties remediated with soil cover will require deed restrictions Detail use restrictions, checklist of items to be inspected during annual site visits
Institutional Control Monitoring Plan (ICMP)	\$5,000.00 LS		1	\$5,000	1	\$5,000	1	\$5,000	
			Subtotal	\$415,000	Subtotal	\$485,000	Subtotal	\$331,000	
Contaminated Soil Excavation and Backfilling <sup>3</sup>									
Contaminated soil excavation - residential	\$75.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Contaminated soil excavation - non-residential	\$50.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Clean fill, placed and compacted - residential	\$55.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Clean fill, placed and compacted - non-residential	\$40.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Topsoil, placed and compacted - residential	\$75.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Topsoil, placed and compacted - non-residential	\$50.00 Cu Yd		0	\$0	0	\$0	0	\$0	
			Subtotal	\$0	Subtotal	\$0	Subtotal	\$0	
Contaminated Soil Transportation and Disposal									
Offsite Hauling and Disposal (non-hazardous)	\$72.00 Cu Yd		3,822	\$275,000	5,147	\$371,000	-	\$0	Includes ex situ treatment of material prior to disposal Collect sample of material for disposal analysis. Includes lab costs + labor. Assume 1 sample per 500 cy of soil for disposal.
Offsite Treatment, Hauling, and Disposal (hazardous)	\$183.00 Cu Yd		288	\$53,000	387	\$71,000	-	\$0	
Acceptance Sampling & Analysis <sup>2</sup>	\$4.86 Cu Yd		4,110	\$20,000	5,535	\$27,000	-	\$0	
			Subtotal	\$348,000	Subtotal	\$469,000	Subtotal	\$0	

**APPENDIX A**  
**BASIS FOR COST ESTIMATES**  
**TABLE A-3**  
**DETAILED COST ESTIMATE, ALTERNATIVE 3: ON-SITE SOIL COVER**  
**USS LEAD SITE OU-1, EAST CHICAGO, INDIANA**

Cost Estimating Activity	Unit Cost	Units	No. of Units <sup>1</sup>	Cost	No. of Units <sup>1</sup>	Cost	No. of Units <sup>1</sup>	Cost	Notes
			EASTERN AREA		SOUTHWESTERN AREA		NORTHWESTERN AREA		
Soil Cover <sup>3</sup>									
Soil Cover, Clean Fill, Placed and Compacted - residential	\$55.00 Cu Yd		5,933	\$326,000	12,681	\$697,000	5,717	\$314,000	Assume 6 inches clean fill for residential properties. Includes site prep, placement and compaction of soil cover
Soil Cover, Clean Fill, Placed and Compacted - non-residential	\$40.00 Cu Yd		4,297	\$172,000	2,554	\$102,000	241	\$10,000	Assume 6 inches clean fill for non-residential properties. Includes site prep, placement and compaction of soil cover
Soil Cover, Topsoil, Placed and Compacted - residential	\$75.00 Cu Yd		5,933	\$445,000	12,681	\$951,000	5,717	\$429,000	Assume 6 inches topsoil for residential properties
Soil Cover, Topsoil, Placed and Compacted - non-residential	\$50.00 Cu Yd		4,297	\$215,000	2,554	\$128,000	241	\$12,000	Assume 6 inches topsoil for non-residential properties
Barrier Fabric	\$0.90 Sq Yd		61,382	\$55,000	91,408	\$82,000	35,748	\$32,000	
			Subtotal	\$1,213,000	Subtotal	\$1,960,000	Subtotal	\$797,000	
Property Restoration <sup>3</sup>									
Sod and landscape - residential	\$7.80 Sq Yd		35,600	\$278,000	76,087	\$593,000	34,300	\$268,000	Applies to non-residential properties (park, church, school, industrial/commercial)
Seed and landscape - non-residential	\$15.70 Sq Yd		25,782	\$405,000	15,321	\$241,000	1,448	\$23,000	Applies to residential properties
Property restoration	\$7.80 Sq Yd		61,382	\$479,000	91,408	\$713,000	35,748	\$279,000	Includes 30 days of landscape maintenance
Final Survey	\$2.74 Sq Yd		61,382	\$168,000	91,408	\$250,000	35,748	\$98,000	
			Subtotal	\$1,330,000	Subtotal	\$1,797,000	Subtotal	\$668,000	
Contractor's Oversight, Health & Safety, Quality Control									
Contractor Health and Safety	\$5,000.00 Month		6	\$30,000	9	\$45,000	3	\$15,000	Assumes 800 cy/week placed as soil cover
Contractor Management and Oversight	\$20,000.00 Month		6	\$120,000	9	\$180,000	3	\$60,000	
Contractor Sub Contracted Quality Control	\$10,000.00 Month		6	\$60,000	9	\$90,000	3	\$30,000	
			Subtotal	\$210,000	Subtotal	\$315,000	Subtotal	\$105,000	
CONSTRUCTION SUBTOTAL				\$4,774,000		\$6,292,000		\$2,830,000	
ENGINEERING AND CONSTRUCTION MANAGEMENT									
Onsite Construction Quality Assurance	\$40,000.00 Month		6	\$240,000	9	\$360,000	3	\$120,000	Oversight, assume 2 field staff onsite during remedial action
Design, Engin., Procurement, Constr. Management & Reporting:	15% Const. cost			\$716,000		\$944,000		\$425,000	Includes remedial design plans, subcontractor procurement, construction status reporting, management oversight
ENGINEERING & CM SUBTOTAL				\$956,000		\$1,304,000		\$545,000	
CONSTRUCTION & ENGINEERING TOTAL				\$5,730,000		\$7,596,000		\$3,375,000	
OPERATIONS AND MAINTENANCE									
Annual O&M	Years		30	\$269,872	30	\$189,044	30	\$209,084	Includes 2 site inspections per year for years 0-5, 1 inspection per year for years 6-30. Soil cover maintenance 1 event per year for years 0-5. See Appendix Table A-6
5 Year Remedy Reviews	Reviews		6	\$27,068	6	\$18,961	6	\$20,971	
Net Present Value of O&M and Remedy Reviews (Interest Rate = 5%)				\$296,940		\$208,005		\$230,055	
TOTAL CONSTRUCTION, ENGINEERING, AND O&M COST				\$6,026,940		\$7,804,005		\$3,605,055	

- Notes
1. See Appendix A, Table A-1, Soil Area and Volume Estimates, for details on all material volumes presented above.
  2. See Appendix A, Table A-7, Sampling Costs, for details on sampling costs
  3. Line items in this subsection of the cost are separated for residential and non-residential properties. Unit costs for non-residential properties are approximately 25% lower than for residential properties due to the larger areas and fewer obstructions within the remedial area

**APPENDIX A  
BASIS FOR COST ESTIMATES  
TABLE A-4**

**DETAILED COST ESTIMATE, ALTERNATIVE 4A: SOIL EXCAVATION OF SOIL EXCEEDING RALS + OFF-SITE DISPOSAL+ EX SITU TREATMENT OPTION  
USS LEAD SITE OU-1, EAST CHICAGO, INDIANA**

Cost Estimating Activity	Unit Cost	Units	No. of Units <sup>1</sup>	Cost	No. of Units <sup>1</sup>	Cost	No. of Units <sup>1</sup>	Cost	Notes
			EASTERN AREA		SOUTHWESTERN AREA		NORTHWESTERN AREA		
REMEDY CONSTRUCTION									
Pre-remedial sampling									
Pre-remedial soil sampling labor	\$84 hrs		4,779	\$403,000	3,348	\$282,000	3,703	\$312,000	Includes pre-field, field, post-field labor, and reporting for remaining 1183 properties in OU-1. Assumes 10 hrs per property. Secure access agreements for pre-remedial sampling and remediation. Assume all 1271 OU-1 properties require access agreements, assume 4 hours per property. Since not all properties have both front and back yards to be remediated, unit cost has been adjusted accordingly. Assume one sample from 7% of yards submitted for TCLP analysis. Assume 4 FTE, 2 field teams, 10 hr/day, 4 hr/property sampled, for pre-remedial sampling labor. Assume 4 FTE, 2 field teams, 10 hr/day, 4 hr/property sampled, for pre-remedial sampling labor
Coordination with Residents	\$165 Yards		1089	\$180,000	763	\$126,000	843	\$139,000	
TCLP analysis (non CLP)	\$110 sample		35	\$4,000	25	\$3,000	27	\$3,000	
Car/Gas	\$600 wk		19	\$11,000	13	\$8,000	15	\$9,000	
Per diem (hotel/food/transportation)	\$156 day		382	\$60,000	268	\$42,000	296	\$46,000	
Materials and equipment	\$120 wk		19	\$2,000	13	\$2,000	15	\$2,000	
Trailer	\$120 wk		19	\$2,000	13	\$2,000	15	\$2,000	
CLP Shipping	\$240 wk		19	\$5,000	13	\$3,000	15	\$4,000	
			Subtotal	\$667,000	Subtotal	\$468,000	Subtotal	\$517,000	
Preconstruction Activities									
Mobilization & Demobilization	\$100,000 LS		1	\$100,000	1	\$100,000	1	\$100,000	Confirm access to properties for remediation. Assume 623 properties require access agreements for remediation, assume 2 hours per property
Coordination with Residents	\$82.55 Yards		435	\$36,000	509	\$42,000	346	\$29,000	
Contractor Prepared Preconstruction Plans									
HASP	\$5,000 LS		1	\$5,000	1	\$5,000	1	\$5,000	
SWPPP Plan	\$15,000 LS		1	\$15,000	1	\$15,000	1	\$15,000	
Traffic Plan	\$10,000 LS		1	\$10,000	1	\$10,000	1	\$10,000	
Work Plan	\$8,000 LS		1	\$8,000	1	\$8,000	1	\$8,000	
Sampling Plan	\$6,000 LS		1	\$6,000	1	\$6,000	1	\$6,000	
			Subtotal	\$180,000	Subtotal	\$186,000	Subtotal	\$173,000	
Site Preparation & Access									
Erosion Controls and Air monitoring	\$1.20 Sq Yd		61,382	\$74,000	91,408	\$110,000	35,748	\$43,000	
Utility locate	\$0.80 Sq Yd		61,382	\$49,000	91,408	\$73,000	35,748	\$29,000	
Pre-remedial site survey	\$4 Sq Yd		61,382	\$239,000	91,408	\$356,000	35,748	\$139,000	
Site clearing	\$2 Sq Yd		61,382	\$98,000	91,408	\$146,000	35,748	\$57,000	
			Subtotal	\$460,000	Subtotal	\$685,000	Subtotal	\$268,000	
Institutional Controls									
Deed Restrictions	\$943 Yards		0	\$0	0	\$0	0	\$0	Required if any soil is left in place below 2 ft bgs that exceeds RALS - Detail use restrictions, checklist of items to be inspected during annual site visits
Institutional Control Monitoring Plan (ICMP)	\$5,000 LS		1	\$5,000	1	\$5,000	1	\$5,000	
			Subtotal	\$5,000	Subtotal	\$5,000	Subtotal	\$5,000	
Contaminated Soil Excavation and Backfilling <sup>1</sup>									
Contaminated soil excavation - residential	\$75 Cu Yd		10,455	\$784,000	23,714	\$1,779,000	10,690	\$802,000	Maximum excavation depth of 24" bgs. Includes labor, dust control, decontamination of equipment clean for residential property excavation. Maximum excavation depth of 24" bgs. Includes labor, dust control, decontamination of equipment clean for non-residential property excavation
Contaminated soil excavation - non-residential	\$50 Cu Yd		7,582	\$379,000	4,775	\$239,000	451	\$23,000	
Clean fill, placed and compacted - residential	\$55 Cu Yd		4,522	\$249,000	11,033	\$607,000	4,974	\$274,000	Assume top 6" of backfill is topsoil material for residential properties. Assume top 6" of backfill is topsoil material for non-residential properties
Clean fill, placed and compacted - non-residential	\$40 Cu Yd		3,285	\$131,000	2,222	\$89,000	210	\$8,000	
Topsoil, placed and compacted - residential	\$75 Cu Yd		5,933	\$445,000	12,681	\$951,000	5,717	\$429,000	
Topsoil, placed and compacted - non-residential	\$50 Cu Yd		4,297	\$215,000	2,554	\$128,000	241	\$12,000	
			Subtotal	\$2,203,000	Subtotal	\$3,793,000	Subtotal	\$1,548,000	

**APPENDIX A  
BASIS FOR COST ESTIMATES**

**TABLE A-4  
DETAILED COST ESTIMATE, ALTERNATIVE 4A: SOIL EXCAVATION OF SOIL EXCEEDING RALS + OFF-SITE DISPOSAL+ EX SITU TREATMENT OPTION  
USS LEAD SITE OU-1, EAST CHICAGO, INDIANA**

Cost Estimating Activity	Unit Cost	Units	No. of Units <sup>1</sup>	Cost	No. of Units <sup>1</sup>	Cost	No. of Units <sup>1</sup>	Cost	Notes
			EASTERN AREA		SOUTHWESTERN AREA		NORTHWESTERN AREA		
<b>Contaminated Soil Transportation and Disposal</b>									
Offsite Hauling and Disposal (non-hazardous)	\$72.00 Cu Yd		16,933	\$1,219,000	26,495	\$1,908,000	10,362	\$746,000	Includes ex situ treatment of material prior to disposal Collect sample of material for disposal analysis. Includes lab costs + labor. Assume 1 sample per 500 cy of soil for disposal.
Offsite Treatment, Hauling, and Disposal (hazardous)	\$183 Cu Yd		1,104	\$202,000	1,994	\$365,000	780	\$143,000	
Acceptance Sampling & Analysis <sup>2</sup>	\$4.86 Cu Yd		18,037	\$88,000	28,489	\$138,000	11,142	\$54,000	
			<b>Subtotal</b>	<b>\$1,509,000</b>	<b>Subtotal</b>	<b>\$2,411,000</b>	<b>Subtotal</b>	<b>\$943,000</b>	
<b>Soil Cover<sup>3</sup></b>									
Soil Cover, Clean Fill, Placed and Compacted - residential	\$55 Cu Yd		0	\$0	0	\$0	0	\$0	Assume 50% of yards excavated to 24" bgs require barrier to be installed, barrier fabric placed at 24" bgs.
Soil Cover, Clean Fill, Placed and Compacted - non-residential	\$40 Cu Yd		0	\$0	0	\$0	0	\$0	
Soil Cover, Topsoil, Placed and Compacted - residential	\$75 Cu Yd		0	\$0	0	\$0	0	\$0	
Soil Cover, Topsoil, Placed and Compacted - non-residential	\$50 Cu Yd		0	\$0	0	\$0	0	\$0	
Barrier Fabric	\$0.90 Sq Yd		921	\$1,000	2,676	\$2,000	1,072	\$1,000	
			<b>Subtotal</b>	<b>\$1,000</b>	<b>Subtotal</b>	<b>\$2,000</b>	<b>Subtotal</b>	<b>\$1,000</b>	
<b>Property Restoration<sup>3</sup></b>									
Sod and landscape - residential	\$15.70 Sq Yd		35,600	\$559,000	76,087	\$1,195,000	34,300	\$539,000	Applies to residential properties
Seed and landscape - non-residential	\$7.80 Sq Yd		25,782	\$201,000	15,321	\$120,000	1,448	\$11,000	Applies to non-residential properties (park, church, school, industrial/commercial)
Property restoration	\$7.80 Sq Yd		61,382	\$479,000	91,408	\$713,000	35,748	\$279,000	Includes 30 days of landscape maintenance
Final Survey	\$2.74 Sq Yd		61,382	\$168,000	91,408	\$250,000	35,748	\$98,000	
			<b>Subtotal</b>	<b>\$1,407,000</b>	<b>Subtotal</b>	<b>\$2,278,000</b>	<b>Subtotal</b>	<b>\$927,000</b>	
<b>Contractor's Oversight, Health &amp; Safety, Quality Control</b>									
Contractor Health and Safety	\$5,000 Month		8	\$40,000	13	\$65,000	5	\$25,000	Assumes 500 cy/wk of contaminated soil excavated.
Contractor Management and Oversight	\$20,000 Month		8	\$160,000	13	\$260,000	5	\$100,000	Assumes 500 cy/wk of contaminated soil excavated.
Contractor Sub Contracted Quality Control	\$10,000 Month		8	\$80,000	13	\$130,000	5	\$50,000	Assumes 500 cy/wk of contaminated soil excavated.
			<b>Subtotal</b>	<b>\$280,000</b>	<b>Subtotal</b>	<b>\$455,000</b>	<b>Subtotal</b>	<b>\$175,000</b>	
<b>CONSTRUCTION SUBTOTAL</b>				<b>\$6,712,000</b>		<b>\$10,283,000</b>		<b>\$4,557,000</b>	
<b>ENGINEERING AND CONSTRUCTION MANAGEMENT</b>									
Onsite Construction Quality Assurance	\$40,000 Month		8	\$320,000	13	\$520,000	5	\$200,000	Oversight, assume 2 field staff onsite during remedial action
Design, Engin., Procurement, Constr. Management & Reporting:	10% Const. cost			\$671,000		\$1,028,000		\$456,000	Includes remedial design plans, subcontractor procurement, construction status reporting, management oversight
<b>ENGINEERING &amp; CONSTRUCTION MANAGEMENT SUBTOTAL</b>				<b>\$991,000</b>		<b>\$1,548,000</b>		<b>\$656,000</b>	
<b>CONSTRUCTION &amp; ENGINEERING TOTAL</b>				<b>\$7,703,000</b>		<b>\$11,831,000</b>		<b>\$5,213,000</b>	
<b>OPERATIONS AND MAINTENANCE</b>									
Annual O&M	Years	30		\$0	30	\$0	30	\$0	See Appendix Table A-6
5 Year Remedy Reviews	Reviews	6		\$27,068	6	\$18,961	6	\$20,971	
<b>Net Present Value of O&amp;M and Remedy Reviews (Interest Rate = 5%)</b>				<b>\$27,068</b>		<b>\$18,961</b>		<b>\$20,971</b>	
<b>TOTAL CONSTRUCTION, ENGINEERING, AND O&amp;M COST</b>				<b>\$7,730,068</b>		<b>\$11,849,961</b>		<b>\$5,233,971</b>	

- Notes
1. See Appendix A, Table A-1, Soil Area and Volume Estimates, for details on all material volumes presented above.
  2. See Appendix A, Table A-7, Sampling Costs, for details on sampling costs
  3. Line items in this subsection of the cost are separated for residential and non-residential properties. Unit costs for non-residential properties are approximately 25% lower than for residential properties due to the larger areas and fewer obstructions within the remedial area.

**APPENDIX A**  
**BASIS FOR COST ESTIMATES**  
**TABLE A-5**  
**DETAILED COST ESTIMATE, ALTERNATIVE 4B: SOIL EXCAVATION TO NATIVE SAND + OFF-SITE DISPOSAL+ EX SITU TREATMENT OPTION**  
**USS LEAD SITE OU-1, EAST CHICAGO, INDIANA**

Cost Estimating Activity	Unit Cost	Units	No. of Units <sup>1</sup> Cost		No. of Units <sup>1</sup> Cost		No. of Units <sup>1</sup> Cost		Notes
			EASTERN AREA		SOUTHWESTERN AREA		NORTHWESTERN AREA		
REMEDY CONSTRUCTION									
Pre-remedial sampling									
Pre-remedial soil sampling labor	\$84.35 hrs		4,779	\$403,000	3,348	\$282,000	3,703	\$312,000	Includes pre-field, field, post-field labor, and reporting for remaining 1183 properties in OU-1. Assumes 10 hrs per property. Secure access agreements for pre-remedial sampling and remediation. Assume all 1271 OU-1 properties require access agreements, assume 4 hours per property. Since not all properties have both front and back yards to be remediated, unit cost has been adjusted accordingly. Assume one sample from 7% of yards submitted for TCLP analysis. Assume 4 FTE, 2 field teams, 10 hr/day, 4 hr/property sampled, for pre-remedial sampling labor. Assume 4 FTE, 2 field teams, 10 hr/day, 4 hr/property sampled, for pre-remedial sampling labor.
Coordination with Residents	\$165.09 Yards		1089	\$180,000	763	\$126,000	843	\$139,000	
TCLP analysis (non CLP)	\$110.00 sample		35	\$4,000	25	\$3,000	27	\$3,000	
Car/Gas	\$600.00 wk		19	\$11,000	13	\$8,000	15	\$9,000	
Per diem (hotel/food)	\$156.00 day		382	\$60,000	268	\$42,000	296	\$46,000	
Materials/team	\$120.00 wk		19	\$2,000	13	\$2,000	15	\$2,000	
Trailer	\$120.00 wk		19	\$2,000	13	\$2,000	15	\$2,000	
CLP Shipping	\$240.00 wk		19	\$5,000	13	\$3,000	15	\$4,000	
			Subtotal	\$667,000	Subtotal	\$468,000	Subtotal	\$517,000	
Preconstruction Activities									
Mobilization & Demobilization	\$100,000.00 LS		1	\$100,000	1	\$100,000	1	\$100,000	Confirm access to properties for remediation. Assume 623 properties require access agreements for remediation, assume 2 hours per property
Coordination with Residents	\$82.55 Yards		435	\$36,000	509	\$42,000	346	\$29,000	
Contractor Prepared Preconstruction Plans									
HASP	\$5,000.00 LS		1	\$5,000	1	\$5,000	1	\$5,000	
SWPPP Plan	\$15,000.00 LS		1	\$15,000	1	\$15,000	1	\$15,000	
Traffic Plan	\$10,000.00 LS		1	\$10,000	1	\$10,000	1	\$10,000	
Work Plan	\$8,000.00 LS		1	\$8,000	1	\$8,000	1	\$8,000	
Sampling Plan	\$6,000.00 LS		1	\$6,000	1	\$6,000	1	\$6,000	
			Subtotal	\$180,000	Subtotal	\$186,000	Subtotal	\$173,000	
Site Preparation & Access									
Erosion Controls and Air Monitoring	\$1.20 Sq Yd		61,382	\$74,000	91,408	\$110,000	35,748	\$43,000	
Utility locate	\$0.80 Sq Yd		61,382	\$49,000	91,408	\$73,000	35,748	\$29,000	
Pre-remedial site survey	\$3.90 Sq Yd		61,382	\$239,000	91,408	\$356,000	35,748	\$139,000	
Site clearing	\$1.60 Sq Yd		61,382	\$98,000	91,408	\$146,000	35,748	\$57,000	
			Subtotal	\$460,000	Subtotal	\$685,000	Subtotal	\$268,000	
Institutional Controls									
Deed Restrictions	\$943.40 Yards		0	\$0	0	\$0	0	\$0	
Institutional Control Monitoring Plan (ICMP)	\$5,000.00 LS		0	\$0	0	\$0	0	\$0	
			Subtotal	\$0	Subtotal	\$0	Subtotal	\$0	
Contaminated Soil Excavation and Backfilling <sup>3</sup>									
Contaminated soil excavation - residential	\$75.00 Cu Yd		21,107	\$1,583,000	45,112	\$3,383,000	20,337	\$1,525,000	Maximum excavation depth of 24" bgs. Includes labor, dust control, decontamination of equipment clean for residential property excavation. Maximum excavation depth of 24" bgs. Includes labor, dust control, decontamination of equipment clean for non-residential property excavation. Assume top 6" of backfill is topsoil material for residential properties. Assume top 6" of backfill is topsoil material for non-residential properties.
Contaminated soil excavation - non-residential	\$50.00 Cu Yd		15,286	\$764,000	9,084	\$454,000	859	\$43,000	
Clean fill, placed and compacted - residential	\$55.00 Cu Yd		15,174	\$835,000	32,431	\$1,784,000	14,620	\$804,000	
Clean fill, placed and compacted - non-residential	\$40.00 Cu Yd		10,989	\$440,000	6,531	\$261,000	617	\$25,000	
Topsoil, placed and compacted - residential	\$75.00 Cu Yd		5,933	\$445,000	12,681	\$951,000	5,717	\$429,000	
Topsoil, placed and compacted - non-residential	\$50.00 Cu Yd		4,297	\$215,000	2,554	\$128,000	241	\$12,000	
			Subtotal	\$4,282,000	Subtotal	\$6,961,000	Subtotal	\$2,838,000	
Contaminated Soil Transportation and Disposal									
Offsite Hauling and Disposal (non-hazardous)	\$72.00 Cu Yd		35,289	\$2,541,000	52,202	\$3,759,000	20,415	\$1,470,000	Includes ex situ treatment of material prior to disposal. Collect sample of material for disposal analysis. Includes lab costs + labor. Assume 1 sample per 500 cy of soil for disposal.
Offsite Treatment, Hauling, and Disposal (hazardous)	\$183.00 Cu Yd		1,104	\$202,000	1,994	\$365,000	780	\$143,000	
Acceptance Sampling & Analysis <sup>2</sup>	\$4.86 Cu Yd		36,394	\$177,000	54,196	\$263,000	21,195	\$103,000	
			Subtotal	\$2,920,000	Subtotal	\$4,387,000	Subtotal	\$1,716,000	
Soil Cover <sup>3</sup>									
Soil Cover, Clean Fill, Placed and Compacted - residential	\$55.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Soil Cover, Clean Fill, Placed and Compacted - non-residential	\$40.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Soil Cover, Topsoil, Placed and Compacted - residential	\$75.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Soil Cover, Topsoil, Placed and Compacted - non-residential	\$50.00 Cu Yd		0	\$0	0	\$0	0	\$0	
Barrier Fabric	\$0.90 Sq Yd		0	\$0	0	\$0	0	\$0	
			Subtotal	\$0	Subtotal	\$0	Subtotal	\$0	

**APPENDIX A**  
**BASIS FOR COST ESTIMATES**  
**TABLE A-5**  
**DETAILED COST ESTIMATE, ALTERNATIVE 4B: SOIL EXCAVATION TO NATIVE SAND + OFF-SITE DISPOSAL+ EX SITU TREATMENT OPTION**  
**USS LEAD SITE OU-1, EAST CHICAGO, INDIANA**

Cost Estimating Activity	Unit Cost	Units	No. of Units <sup>1</sup> Cost		No. of Units <sup>1</sup> Cost		No. of Units <sup>1</sup> Cost		Notes
			EASTERN AREA		SOUTHWESTERN AREA		NORTHWESTERN AREA		
Property Restoration <sup>3</sup>									
Sod and landscape - residential	\$15.70 Sq Yd		35,600	\$559,000	76,087	\$1,195,000	34,300	\$539,000	Applies to residential properties
Seed and landscape - non-residential	\$7.80 Sq Yd		25,782	\$201,000	15,321	\$120,000	1,448	\$11,000	Applies to non-residential properties (park, church, school, industrial/commercial)
Property restoration	\$7.80 Sq Yd		61,382	\$479,000	91,408	\$713,000	35,748	\$279,000	Includes 30 days of landscape maintenance
Final Survey	\$2.74 Sq Yd		61,382	\$168,000	91,408	\$250,000	35,748	\$98,000	
			Subtotal	\$1,407,000	Subtotal	\$2,278,000	Subtotal	\$927,000	
Contractor's Oversight, Health & Safety, Quality Control									
Contractor Health and Safety	\$5,000.00 Month		14	\$70,000	20	\$100,000	8	\$40,000	Assumes 620 cy/wk of contaminated soil excavated.
Contractor Management and Oversight	\$20,000.00 Month		14	\$280,000	20	\$400,000	8	\$160,000	Assumes 620 cy/wk of contaminated soil excavated.
Contractor Sub Contracted Quality Control	\$10,000.00 Month		14	\$140,000	20	\$200,000	8	\$80,000	Assumes 620 cy/wk of contaminated soil excavated.
			Subtotal	\$490,000	Subtotal	\$700,000	Subtotal	\$280,000	
CONSTRUCTION SUBTOTAL				\$10,406,000		\$15,665,000		\$6,719,000	
ENGINEERING AND CONSTRUCTION MANAGEMENT									
Onsite Construction Quality Assurance	\$40,000.00 Month		14	\$560,000	20	\$800,000	8	\$320,000	Oversight, assume 2 field staff onsite during remedial action Includes remedial design plans, subcontractor procurement, construction status reporting, management oversight
Design, Engin., Procurement, Constr. Management & Reporting:	10% Const. cost			\$1,041,000		\$1,567,000		\$672,000	
ENGINEERING & CONSTRUCTION MANAGEMENT SUBTOTAL				\$1,601,000		\$2,367,000		\$992,000	
CONSTRUCTION & ENGINEERING TOTAL				\$12,007,000		\$18,032,000		\$7,711,000	
OPERATIONS AND MAINTENANCE									
Annual O&M		Years	30	\$0	30	\$0	30	\$0	
5 Year Remedy Reviews		Reviews	6	\$0	6	\$0	6	\$0	
Net Present Value of O&M and Remedy Reviews (Interest Rate = 5%)				\$0		\$0		\$0	
TOTAL CONSTRUCTION, ENGINEERING, AND O&M COST				\$12,007,000		\$18,032,000		\$7,711,000	

- Notes
1. See Appendix A, Table A-1, Soil Area and Volume Estimates, for details on all material volumes presented above.
  2. See Appendix A, Table A-7, Sampling Costs, for details on sampling costs
  3. Line items in this subsection of the cost are separated for residential and non-residential properties. Unit costs for non-residential properties are approximately 25% lower than for residential properties due to the larger areas and fewer obstructions within the remedial area.

**APPENDIX A**  
**BASIS FOR COST ESTIMATES**  
**TABLE A-6**  
**OPERATION AND MAINTENANCE COST ESTIMATE**  
**USS LEAD SITE OU-1, EAST CHICAGO, INDIANA**

**Alternative 3: On-Site Soil Cover**

***Cover Inspections & Repair***

2 people for 2 days (with travel) at \$1,200 per person per day =	\$4,800
ODCs (car, per diem)	\$250
Total	\$5,050 per event
First 5 years - semi-annual =	\$10,100 per year
Years 6 through 30, annual =	\$5,050 per year

***Soil Cover Maintenance***

First 5 years, assume 5 days of grading and seeding/sodding soil cover Crew with mobilization/equipment/supplies (includes pre-field work, site prep) =	\$50,000 per year
Years 5-30, assume 2 days of grading and seeding/sodding soil cover Crew with mobilization/equipment/supplies (includes pre-field work, site prep) =	\$25,000 per year

***Institutional Control Review***

***Institutional Control Review Site Visit***

2 people for 1 day (with travel) at \$1,200 per person per day =	\$2,400
ODCs (car, per diem)	\$250
Total	\$2,650 per event

***Institutional Control Review Report***

20 hrs	\$120 hr	\$2,400
	Total	\$2,400 per year

***Remedy Review***

***Five Year Review - Site Inspection***

*Includes site visit to inspect each remediated yard*

2 people for 2 days (with travel) at \$1,200 per person per day =	\$4,800
ODCs (car, per diem)	\$250
Total	\$5,050 per event

***Five Year Review Report***

150 hrs	\$120 hr	\$18,000
ODCs		\$1,000
	Total	\$19,000 per event

**APPENDIX A**  
**BASIS FOR COST ESTIMATES**  
**TABLE A-6**  
**OPERATION AND MAINTENANCE COST ESTIMATE**  
**USS LEAD SITE OU-1, EAST CHICAGO, INDIANA**

**Alternative 4A: Soil excavation of soil exceeding RALs + ex situ treatment + Off-site disposal**

***Remedy Review***

***Five Year Review - Site Inspection***

*Includes site visit to inspect each remediated yard*

2 people for 2 days (with travel) at \$1,200 per person per day =	\$4,800
ODCs (car, per diem)	\$250
Total	\$5,050 per event

***Five Year Review Report***

150 hrs	\$120 hr	\$18,000
ODCs		\$1,000
Total		\$19,000 per event

**Alternative 4B: Soil excavation to native sand + Ex-Situ Treatment + Off-site disposal**

***Remedy Review***

***Five Year Review - Site Inspection***

2 people for 2 days (with travel) ay \$1,200 per person per day =	\$0
ODCs (car, per diem)	\$0
Total	\$0 per event

***Five Year Review Report***

0 hrs	\$120 hr	\$0
ODCs		\$0
Total		\$0 per event

**Alternative 1: No Action**

***Remedy Review***

***Five Year Review - Site Inspection***

*Includes site visit to inspect each remediated yard*

2 people for 1 day (with travel) at \$1,200 per person per day =	\$2,400
ODCs (car, per diem)	\$100
Total	\$2,500 per event

***Five Year Review Report***

75 hrs	\$120 hr	\$9,000
ODCs		\$1,000
Total		\$10,000 per event

APPENDIX A  
BASIS FOR COST ESTIMATES  
TABLE A-7  
SAMPLING COSTS  
USS LEAD SITE OU-1, EAST CHICAGO, INDIANA

		Sampling Event								Analytical Costs per sample									
Item Group	Line Item	# days	Labor \$/day	No. Yards	Unit	Labor/res. Yard	Soil Material	Unit	No. Samples	Metals	TCLP Metals	Disposal Analysis <sup>1</sup>	Analytical Sub Total	Analytical Rush Surcharge (72 hr) (60%)	Total	Cost/unit	Unit	Notes	
<b>Pre-Remedial Sampling</b>																			
Pre-Remedial Sampling	TCLP Analysis	NA	NA	237	yards	NA	NA		949		\$110.00	--	\$104,412.00		\$104,412.00	\$110.00	sample	Assume 13.5% of samples exceed TCLP threshold of 2,425 mg/kg total lead. Analytical costs for TCLP analysis only presented here. Other analytical will be performed by a CLP laboratory. Assume 4 samples per yard.	
<b>Alternative 3 SOIL</b>																			
Contaminated Soil for Disposal	Acceptance Sampling & Analysis	125.6	\$168.70	--	--	--	12,558	CY	25	\$90.00	--	\$900.00	\$24,864.31	\$14,918.59	\$60,967.80	\$4.86	CY	Assumes 2 hrs/day to collect samples for disposal/confirmation analysis. Assumes 1 sample per 500 cy soil for metals and disposal analysis.	
<b>Alternative 4A SOIL</b>																			
Contaminated Soil for Disposal	Acceptance Sampling & Analysis	576.7	\$168.70	--	--	--	57,668	CY	115	\$90.00	--	\$900.00	\$114,181.75	\$68,509.05	\$279,975.97	\$4.86	CY	Assumes 2 hrs/day to collect samples for disposal/confirmation analysis. Assumes 1 sample per 500 cy soil for metals and disposal analysis.	
<b>Alternative 4B SOIL</b>																			
Contaminated Soil for Disposal	Acceptance Sampling & Analysis	1,117.9	\$168.70	--	--	--	111,785	CY	224	\$90.00	--	\$900.00	\$221,334.96	\$132,800.97	\$542,717.78	\$4.86	CY	Assumes 2 hrs/day to collect samples for disposal/confirmation analysis. Assumes 1 sample per 500 cy soil for metals and disposal analysis.	

Notes  
1. Disposal Analysis includes: pH (\$10), reactive cyanide (\$30), TCLP RCRA 8 metals (\$110), TCLP SVOCs (\$200) VOCs (\$120), PCBs (\$120), Flash Point (\$25), Paint Filter (\$15), Pesticides/Herbicides (\$270)